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PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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THE INSTITUTION OF ELECTRICAL ENGINEERS

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THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
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ABSTRACTS 8421–9198

VOLUME 53 DECEMBER 1950 NUMBER 636

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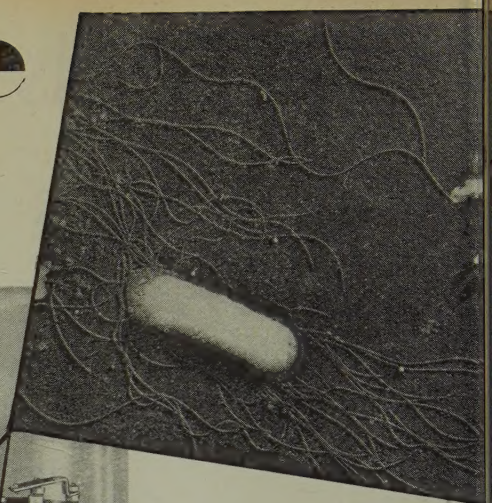
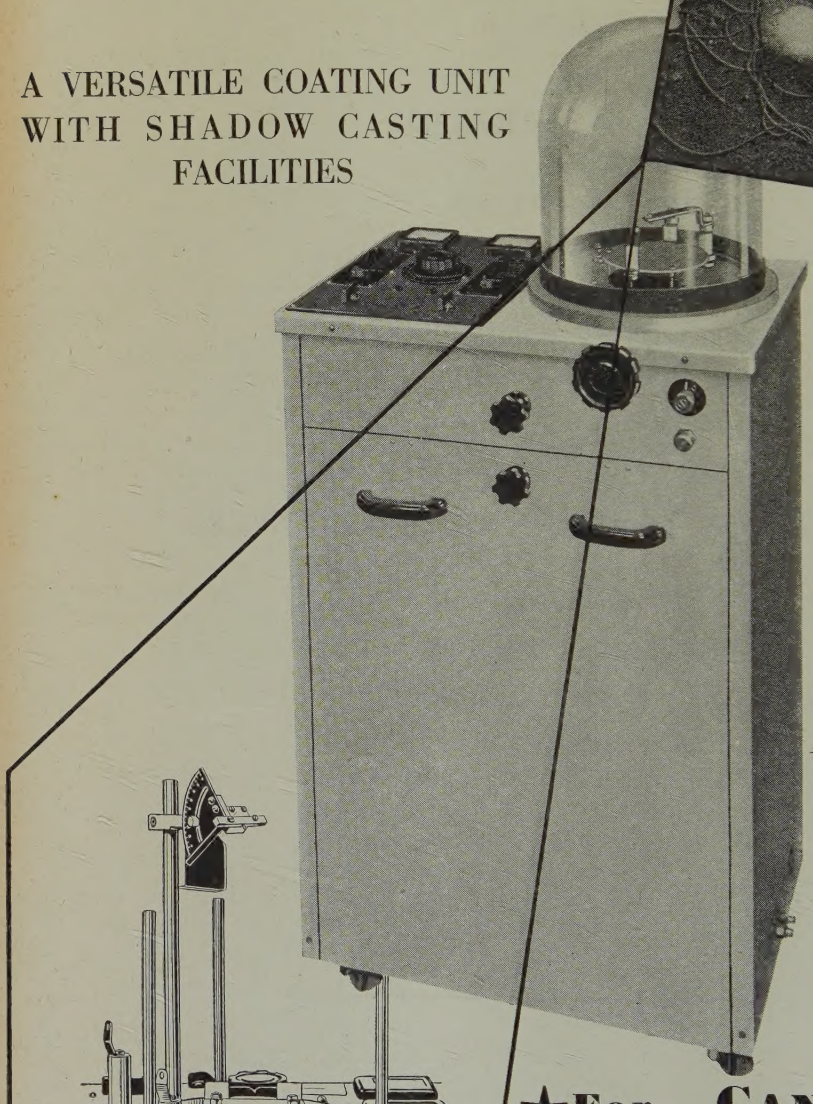


Bacillus Proteus shadowed with chromium metal, showing wavy uniformly wide Flagella. (Reproduced by the courtesy of the Department of Biomolecular Structure Leeds University.)



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Electrical and magnetic measurements and instruments
Electronic relays and counters
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Applied electrochemistry
Photocells
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Cathode-ray tubes
X-ray tubes
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Radiocommunication
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It is regretted that the articles from which abstracts are made cannot be sent out on loan. Application should be made to appropriate lending libraries or to the publisher of the Journal concerned; publishers' addresses, where known, are given in the "List of Journals" published with the January Number of Vol. 53 (1950), or in the supplementary lists published subsequently.

ERRATA

Abstr. 1167, lines 5 and 6: *for* Abstr. 3921 (1949) *read* Abstr. 3921 (1948).

Abstr. 3369, line 3: *for* D. G. BALIGINSKI *read* D. G. BULYGINSKI.

Abstr. 3516, lines 2 and 3: *for* journal reference *read Acta Cryst.*, 3 (*No.* 2) 155–8 (1950).

Abstr. 3542, line 3: *for* (*No.* 1) *read* (*No.* 2).

Abstr. 3625, line 5: *for* Abstr. 2106 *read* Abstr. 2102.

Abstr. 4477, 4481, 4483, 4485, 4490: journal reference, *for* (*No.* 3) *read* (*No.* 2).

Abstr. 4496, line 3: journal reference, *after* **3** *insert* (*No.* 2).

Abstr. 5910, line 4: *for* "the above" *read* "Abstr. 5908 (1950)."

Abstr. 7917, lines 1 and 2: *for* M. DUFFIEUX *read* P. M. DUFFIEUX.

Abstr. 8183: line 3: delete "69" and *after* journal reference *insert* "See Abstr. 6706 (1950) of which the title should read **Measurement of a $1{\cdot}6 \times 10^{-9}$ second half-life in Yb 170.**"

Abstr. 8338, line 2: *for* M. SULLIVAN *read* B. M. SULLIVAN.

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REPORT OF INTERNATIONAL CONFERENCE ON FUNDAMENTAL PARTICLES (Vol. I) and LOW TEMPERATURES (Vol. II), Cambridge, 1946

THE EMISSION SPECTRA OF THE NIGHT SKY AND AURORAE

Papers read at an International Conference held under the auspices of the Gassiot Committee, London, July, 1947.

THE STRENGTH OF SOLIDS

Report of Conference, Bristol, July, 1947.

RESONANT ABSORBERS AND REVERBERATION

Report of the 1947 Summer Symposium of the Acoustics Group of the Physical Society.

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MATHEMATICS 51

517.392 : 523.877

8421. Quadrature formulae for the numerical calculation of mean intensities and fluxes in a stellar atmosphere. A. REIZ. *Ark. Astron.*, **1**, *Paper* 13, 147–53 (1950).

Integrals of the type $\int_0^\infty f(x)w(x)dx$ are written as $\sum_{i=1}^{\nu} p_i f(x_i)$, where the p_i depend only on the weight function $w(x)$. Values of x_i and p_i are given for $w(x) = e^{-x}$, and for $w(x) = \int_1^\infty e^{-tx}t^{-n}dt$, where n is an integer $\leqslant 5$.

R. A. NEWING

517.63

8422. An alternative method for the summation of Fourier series. I. F. MORRISON. Letter in *J. Appl. Phys.*, **21**, 939 (*Sept.*, 1950).—See Abstr. 3683 (1950).

517.86 : 534.232

8423. On the extension of some Lommel integrals to Struve functions with an application to acoustic radiation. C. W. HORTON. *J. Math. Phys.*, **29**, 31–7 (*April*, 1950).

517.9

8424. On the convergence of the perturbation method. II (2). T. KATO. *Progr. Theor. Phys.*, **5**, 207–12 (*March–April*, 1950).

The conclusions of a previous paper [see Abstr. 5408 (1950)] are extended to higher approximations, and to the case of degenerate eigenvalues. The general conclusion is that the series given by perturbation methods are correct only if the coefficients can be calculated by means of operations within the Hilbert space. Examples are given. L. PINCHERLE

517.947.4

8425. A variational method appropriate to the study of the wave equation. T. KAHAN. *Rev. Sci., Paris*, **87**, 205–11 (*Oct.–Dec.*, 1949) *In French.*

An analogy with electrostatic potential is used to express solutions in terms of an integral equation. An approximate solution of the latter equation is obtained in the form $\rho = a_1V_1 + a_2V_2 + \ldots + a_nV_n$, where the functions V are constructed by an iterative process, and the coefficients a are chosen by a least squares method. R. A. NEWING

518.4 : 621.71

8426. Practical engineering uses of probability paper. I–II. A. BOYAJIAN. *Gen. Elect. Rev.*, **53**, 15–21 (*June*); 41–3 (*July*, 1950).

Much information can be obtained from test data by plotting the mean value on probability paper at $x = 50$ and the mean plus the standard deviation at $x = 84$, and then drawing a straight line joining these points. From the diagram can be found the probability of a result less than a certain value and probability bands can be drawn on the diagram giving indication of justified degrees of probability. Tests are given to indicate whether the normal distribution law applies to the data and thus justify using probability paper. A table is given of a range of values of probability integrals and a few selected examples are compared with the results obtained by using the probability paper, it being shown that the latter is sufficiently accurate for most engineering purposes.

A. C. WHIFFIN (R)

518.5

8427. Characteristics of the Institute for Numerical Analysis Computer. H. D. HUSKEY. *Math. Tables Aids Comput.*, **4**, 103–8 (*April*, 1950).

80% of the machine was complete on Dec. 1, 1949. Its high-speed memory can hold 512 numbers and instructions of 41 binary digits. Auxiliary magnetic drums to hold 8 192 words, access time 8 msec, are under construction. Thirteen operations are available. Addition and multiplication require 64 and 384 μsec. Floating point operations are subroutined. A 4-address code is used. S. MICHAELSON

518.5 : 621.316.313

8428. Solution of a system of linear equations with a slightly unsymmetrical matrix by using a network analyzer. H. L. KNUDSEN. *Trans Danish Acad. Tech. Sci.* (*No.* 2) 16 *pp.* (1950).

A related symmetrical matrix is derived and set up on the analyser, and an iteration process used to obtain the solution. The convergence of this process is discussed. B. L. COLEMAN (R)

518.5 : 621.318.572 : 621.389

8429. An electronic integral-transform computor and the practical solution of integral equations. H. WALLMAN. *J. Franklin Inst.*, **250**, 45–62 (*July*, 1950).

An instrument (not yet completed) is described, without technical details, for rapid computations (*ca.* 0·1 sec) of functions of the form $\int_a^b K(x, t)f(t)dt$, x and t being real variables, a and b finite, x-values being taken in discrete steps but t being continuous. Conversion of $K(x, t)$ into a proportional time-dependent voltage is achieved by a photographic plate composed of parallel strips of optical opacity proportional to the function value. Each strip corresponds to an x-value, a plate being prepared for each required $K(x, t)$. This is then interposed in a high-speed television scanner. Conversion of $f(t)$ into voltage is achieved by the method employing a profile of the function placed over the tube face: the beam is then driven over its outline. After a multiplier and averager the resultant voltage-function is applied to a c.r.o. Minor changes provide a means of handling non-linear integral transforms. A mathematical discussion of its applications includes Fourier and Hilbert transforms and integral equations—in particular certain boundary-value problems.

A. J. KENNEDY (R)

518.5 : 621.392.2 : 621.3.012.8

8430. Feedback in chains and networks of electrical analogues. P. GRIVET AND Y. ROCARD. *Rev. Sci., Paris*, **87**, 85 (*April–June*, 1949) *In French.*

Indicates how the range of representation of ordinary and partial differential equations can be greatly extended by using feedback circuits acr network branches. B. L. COLEMAN

519.28

8431. Runs up and down on a lattice. P. V. K. Iyr Letter in *Nature, Lond.*, **166**, 276 (*Aug.* 12, 1950).

Outline of a method of obtaining moments of t type of distribution. N. L. JOHNS

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.2

8432. The development of the astronomical telescope. E. F. FREUNDLICH. *J. Sci. Instrum.*, **27**, 233–7 (*Sept.*, 1950).

522.21 : 535.87

8433. Practical applications of high and low reflecting films on glass. J. STRONG. *J. Phys. Radium*, **11**, 441–3 (*July*, 1950).

Gives information of recent advances in methods of aluminizing glass mirrors, particularly the 200 in Palomar mirror, with a brief report on non-reflecting films. E. G. MARTIN

522.61 : 778.3

8434. The use of photographic material in astronomy. D. KOELBLOED. *Ned. J. Natuurkde*, **16**, 145–52 (*July*, 1950) *In Dutch.*

Review of publications on features of the photographic plate important for astronomy. The method is compared with photoelectric methods. The probable sources of error in position measurements are reviewed: i.e. changes in atmospheric refraction, deformation of plates by contraction of emulsion, distortion of emulsion, Ross and Kostinsky effects, colour sensitivity, vibration of telescope and lens errors. Errors in intensity measurements are caused by unevenness of material, faults in developing, statistical distribution of Ag particles, irregularity of glass plates and emulsions and spurious light. Methods of overcoming these errors are reviewed.

C. TURNER

523.1

8435. A new approach to cosmology. A. E. H. BLEKSLEY. *S. Afr. J. Sci.*, **47**, 13–15 (*Aug.*, 1950).

Pt. I, Abstr. 7691 (1950). Certain cosmological consequences of the uncertainty principle are traced, starting from the earlier assumption of a finite age T of the universe: there exist a minimum significant energy $\varepsilon = 10^{-43}$ ergs, and a minimum significant mass $\mu = 10^{-64}$ g; the radius of the universe $R = cT = 2\times10^{9}$ light years; the number of particles in the universe is $2{\cdot}56\times10^{79}$, and the total mass 2×10^{55} g. The mean density is therefore 6×10^{-28} g/cm^3; the rate of recession v of the galaxies at distance r from the observer is found on certain assumptions to be given by $v/r = 1/3T$, which does not agree very well with observations. The maximum rate of recession is thus one-third the velocity of light, which is a conclusion that should soon be capable of observational test; the mass of the proton is found to be $1{\cdot}63\times10^{-24}$ g; the minimum mass of the meson is found to be about 70 electron masses; the charges on the proton and the electron are not correctly evaluated the present theory.

523.1

8436. An interpretation of the expansion of t universe. E. BAGGE. *Z. Phys.*, **128** (*No.* 2) 239– (1950) *In German.*

The expansion is interpreted in terms of the Ne tonian parabolic universe already considered Milne [*Quart. J. Math.*, **5**, 64–72 (1934)]. An attem is also made to examine the effect on the recession la when allowance is made for the relativistic variatio of mass with velocity. The physical origin of t expansion process is also discussed. R. A. NEWIN

523.12 : 539.

8437. Proton-neutron concentration ratio in t expanding universe at the stages preceding the form tion of the elements. C. HAYASHI. *Progr. Theor. Phy* **5**, 224–35 (*March–April*, 1950).

Primordial matter is assumed to have an appreciab proton content. Reaction rates between elementa particles are discussed assuming initial temperatur $\sim 10^{10}$ °K. The variation of the neutron-proton rat with time is investigated, and found to be approx mately 1 : 4 at the beginning of element formatio almost independently of its initial value. R. A. NEWI

523.161 : 538.5

8438. Present views on the galactic radio noi R. GALLET. *Rev. Sci., Paris*, **87**, 157–61 (*July–Sep* 1949) *In French.*

Difficulties in assuming the radiation to origina either in the stars, or the interstellar electron g (free-free collisions and plasma oscillations a considered) are discussed. A possible way out l in the abandonment of the usual assumption thermal equilibrium in the interstellar gas. In t way the observed intensities of radio noise may explained without ascribing impossibly high te peratures to the interstellar gas. E. P. GEOR

523.162.1 : 535.

8439. The amount of polarization by interstel grains. H. C. VAN DE HULST. *Astrophys. J.*, **112**, (*July*, 1950).

The extinction of light by long dielectric cylinder computed for different directions of polarizati Cylinders with diameters of the order of the wa length give the correct dependence of interstel polarization on wavelength, whereas cylinders ellipsoids small compared to the wavelength do n The computed amount of polarization is bar sufficient to explain the observations, even if the gra are strongly elongated and fully aligned.

523.53 : 551.510.535

8440. A comparison of meteor activity with occurrence of sporadic *E* reflections. V. C. PINEO. *Science*, **112**, 50–1 (*July* 14, 1950).

A statistical study has been made of the reflections from meteor trails at 27·2Mc/s, and of sporadic *E* reflections. The meteor equipment was in almost continuous operation from Nov. 1, 1948, to April 30, 1949, more than 62 000 meteor reflections being recorded. The apparatus for determining the sporadic *E* reflections recorded ionospheric data at 15 min intervals, 16 700 records being obtained. A study of the variation with time of the two phenomena indicates that they are not related.

W. T. BLACKBAND

523.59

8441. Spectrum of the zodiacal light. G. A. TIKHOV. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 1) 53–4 (1950) *In Russian.*

523.7 : 538.12 : 550.38

8442. Discussion of the origin of the terrestrial and solar magnetic fields. H. ALFVÉN. *Tellus*, **2**, 74–82 (*May*, 1950).

An original meridional field can by hydrodynamic motion get an east-west component. It is pointed out that this component cannot exceed the order of magnitude of the original field. If it does, the field becomes unstable and an increase of the meridional component is caused. The possibility of finding an amplifying mechanism of this type is considered. A.

523.72 : 621.396.11

8443. A contribution to the study of solar radio emissions. J. F. DENISSE. *Ann. Astrophys.*, **13**, 181–202 (*April–June*, 1950) *In French.*

A survey of the general characteristics of the emissions in the cm-, dm- and m-wave ranges is followed by a brief review of the various theories which have been proposed to explain them. A study of the geometrical and optical properties of an idealized solar model whose temperature and electron density distribution is given, yields an estimate of the emission of the quiet sun which is satisfactory for the corona (confirming its high degree of excitation), but which requires a temperature at the base of the chromosphere much smaller than that indicated by observation. The slow fluctuations on dm-wavelengths are explained by the gyromagnetic effect associated with the magnetic fields of sunspots; the observed emission, proportional to spot-area, corresponds to a coronal temperature $> 4 \times 10^6$°. The perturbations due to prominences, solar flares and variations of the topography of the spots are considered.

M. W. OVENDEN

523.73

8444. An attempt at a dynamical theory of the solar atmosphere. F. SCHMEIDLER. *Z. Naturforsch.*, **5a**, 297–308 (*June*, 1950) *In German.*

A model for the sun with a rotating core of large equatorial velocity is assumed. The hydrodynamical equations are simplified by assuming: (*a*) the vertical thickness of the atmosphere is very much less than the solar radius *R*; (*b*) there are no specifically zonal forces; (*c*) the frictional forces are due to vertical exchanges of material; (*d*) second-order velocity terms are negligible; and (*e*) a constant density. These equations are then integrated, using the observed drifts of faculae, prominences, etc., as boundary conditions. It is found possible to explain the non-uniform rotation of the sun as due to the combination of 3 forces, viz. Coriolis force, turbulent friction and a force between pole and equator whose nature is unknown but whose existence is indicated by the observed meridional drifts. If this force is assumed due to a difference of temperature between pole and equator, a difference of less than 100° would suffice.

M. W. OVENDEN

523.73 : 537.311.37 : 538.122

8445. The effect of turbulence on a magnetic field. P. A. SWEET. *Mon. Not. Roy. Astron. Soc.*, **110** (*No.* 1) 69–83 (1950).

The work of a previous paper [Abstr. 4627 (1950)] on the effect of steady large-scale convection currents on a magnetic field is extended to include turbulent convection. It is shown that turbulence reduces the effective electrical conductivity of a gas, in some cases to a small fraction of its normal value. A.

523.752

8446. Theory of the chromosphere. L. E. GUREVICH AND A. I. LEBEDINSKIĬ. *J. Exp. Theor. Phys., USSR*, **20**, 566–71 (*June*, 1950) *In Russian.*

The existing hypotheses about the physical character of the phenomena leading to the observed abnormally slow decrease of the density are critically reviewed, in particular Milne's theory of selective radiation pressure, McCrea's turbulence theory and the synthesis of both these viewpoints by Chandrasekhar. The author then presents his own hypothesis that the turbulent state of the upper layers of the chromosphere is due to rapidly fluctuating magnetic fields, produced by the convection of the heavily ionized gas of the granules. He shows that these turbulizing forces are capable of maintaining a chromosphere of the observed mass, and that all the former theories lead to substantially smaller values of the mass than the actual one. Eventually the inconsistency of Severnyi's assumption of the turbulence being due to the non-uniformity of the sun's speed of rotation is demonstrated. B. F. KRAUS

523.77

8447. On the theory of the Fraunhofer lines in the solar atmosphere. Z. HITOTUYANAGI. *Jap. J. Astron. Geophys.*, **21** (*Nos* 1–2) 87–124 (1944) *In German.*

This further development of methods used by Strömgren attempts the calculation of line contours in their relation to the distance from the centre of the sun's disc. Numerical comparison with various stellar models and observations by Allen and Houtgast shows that the new intensity formula gives qualitatively satisfactory representations. A special section deals with the line wings which are discussed in conjunction with Minnaert's and Unsöld's theories.

A. BEER

523.77

8448. Effect of non-coherent scattering on the centre-limb variation of strong Fraunhofer lines. Z. SUEMOTO. *Publ. Astron. Soc. Japan*, **1** (*No.* 3) 78–85 (1949).

Houtgast's work on the centre-limb variation of

Fraunhofer lines (Dissertation Utrecht, 1942) is rediscussed theoretically; particularly his explanations based on non-coherent scattering, introduced as a mechanism to produce "extinction" in the upper layers of the sun's atmosphere. A. BEER

523.77 : 535.343–15

8449. Fine structure of N_2O bands in the infrared solar spectrum. M. V. MIGEOTTE. *Astrophys. J.*, **112,** 136–40 (*July*, 1950).

Absorption bands due to N_2O in the earth's atmosphere have been observed and resolved under high dispersion near $8{\cdot}6\,\mu$, $4{\cdot}5\,\mu$ and $3{\cdot}9\,\mu$. The first of these is the band $2\nu_2$ observed by Plyler and Barker, while the second is the fundamental ν_3. This band is readily resolved in the atmosphere but is difficult to resolve in the laboratory. The N_2O band at $3{\cdot}9\,\mu$ was observed and resolved in an exploration, but was not measured again owing to technical difficulties. A.

523.821

8450. Investigations on colour indices. I. The deviation of star radiation from black radiation. II. The colour-brightness diagram of the nearest stars. S. GÜNTHER. *Z. Astrophys.*, **27** (*No.* 2) 167–92 (1950) *In German.*

523.821

8451. The colour-brightness diagram of the Pleiades. S. GÜNTHER. *Z. Astrophys.*, **27** (*No.* 2) 107–31 (1950) *In German.*

523.84

8452. Stellar magnetic fields. H. W. BABCOCK. *Nature, Lond.*, **166,** 249–51 (*Aug.* 12, 1950).

General magnetic fields have been observed in 25 peculiar and spectrum-variable stars of types *A* or early *F* and in nearly all their magnetic field is variable. Electromagnetic processes are thus important. A study of HD125248 is described in detail. Certain Fe and Ti lines give the polar field strength of this star at time t as $2\,000 + 6\,600\cos\theta - 1\,600\cos 2\theta$ gauss, where $\theta = 2\pi\nu t$ and $\nu = 1{\cdot}25$ micro-cycles/sec. Radial velocity measurements show an anharmonic variation which seems coupled to the magnetic changes but whose amplitude is different for different elements. The principal term in the magnetic variation ($6\,600\cos\theta$) is interpreted as due to the radial oscillation of the star in its magnetic field. The alternative model (oblique rotator) in which the dipole axis is inclined to the axis of rotation is ruled out on various grounds. Stars such as HD125248 which behave as a magnetic oscillator may be sources of cosmic rays emitted along the dipole axis by a process suggested by W. F. G. Swann. It is suggested that the 22-year solar cycle may be the result of a slow residual magnetic oscillation of small amplitude. The bearing of stellar magnetic fields on electromagnetic theories of cosmogony (Alfven, Birkland) is discussed. V. C. A. FERRARO

523.841.11

8453. Supernovae. L. B. BORST. Letter in *Phys. Rev.*, **78,** 807–8 (*June* 15, 1950).

Summary of a new theory designed to account for all observational facts. The author proposes a mechanism whereby the original star, of, e.g., $15\times$ sun's mass, undergoes gravitational contraction after burning its H. As the contraction progresses, t central temperature rises to $2–3\times10^9$ °c when 2nd-order endothermic reaction will occur betwe alpha-particles: $2\alpha \rightarrow Be^7 + n$; reaction thresh $Q = -18{\cdot}6$ MeV. Rapid gravitational collap follows. When sufficient concentration of t reaction products is reached the reverse reacti sets in. The star eventually becomes unstable a explodes, driving off a considerable part of its ma as an expanding gas cloud. Possible mechanisms this explosion are described. The initially remaini essential energy source is Be^7 ($T = 52{\cdot}9$ days), which a quantity of 3×10^{32} g would be require Experiments to measure the Be^7 yield of the (α, reactions will be initiated. A. BE

523.841

8454. On the change of period of eclipsing variab stars. F. B. WOOD. *Astrophys. J.*, **112,** 196–2 (*July*, 1950).

Irregular period fluctuations of eclipsing syste are discussed. It is pointed out that, when t elements of systems showing such fluctuations ha been determined, the systems are, with one exceptio at or near the limits of dynamical stability. A possibl explanation of this correlation and of the perio changes themselves is suggested.

523.83

8455. The gravitational galactic force and the densi of interstellar matter. J. SCHILT. *Astron. J.*, **55,** 9 111 (*May*, 1950).

A detailed analysis is made of stellar velocities right angles to the galactic plane, and it is conclude that these velocities cannot be represented as a su of Gaussian distributions about a common mod value. The plane of symmetry is found to be fro 6 to 7 parsecs north of the sun, and stars are divide into discrete classes whose members pass through th plane with approximately equal velocities. The mea density of matter within a few parsecs of the plane found to be $5{\cdot}3\times10^{-22}$ g/cm^3, and the period oscillation of a star perpendicular to the plane $\sim 10^7$ years. R. A. NEWIN

523.87

8456. On the discontinuities of the distribution masses and hydrogen-content in the Hertzsprung Russell diagram. A. OPOLSKI. *Ark. Astron.*, **1,** *Pape* 14, 155–74 (1950).

On the basis of masses, absolute magnitudes an spectral types of binary stars one may determine th position of the constant-mass lines on a Hertzsprung Russell diagram. These lines show the discontinuitie in the upper part of the main sequence at the limit $M_{bol} = +2^m{\cdot}4$, $-0^m{\cdot}5$ and $-3^m{\cdot}1$. The abrup changes of masses at these values are connected wit corresponding changes of hydrogen-content, an they may be regarded as an explanation of th distribution of the absolute magnitudes of stars some open clusters. The existence of these limits ma be connected with the appearance of variable stars RR Lyrae type. The characteristic shape of th luminosity diagram showing the Hγ intensity/M_{p} relation may also be connected with the divisions the main-sequence stars in some groups.

523.875

8457. Methods of determining the brightness temperatures of a star. D. CHALONGE AND L. DIVAN. *C.R. Acad. Sci., Paris*, **231**, 215–17 (*July* 17, 1950) *In French.*

The brightness temperatures of 2 stars (β Per., β Aur.) of known radius and distance are computed, for the effective λ of visual magnitudes; by comparison with the corresponding solar data. Brightness temperatures, T_0, for the central Balmer line absorptions are then deduced from known residual intensities and found to agree for all the lines in one star. T_0 (and hence the brightness temperature at any λ) may be found for stars of similar type even though of unknown radius, from their residual intensities and colour temperatures. Thus the factors p relating brightness and colour temperatures [see Abstr. 6977 (1950)] may be found for such stars. D. L. EDWARDS

523.875 : 551.583.3

8458. Secular changes of stellar structure and the ice ages. E. J. ÖPIK. *Mon. Not. Roy. Astron. Soc.*, **110** (*No.* 1) 49–68 (1950).

A sudden increase in the rate of nuclear energy generation by a certain amount leads to expansion and to a decrease of the luminosity by nearly an equal amount (if measured in stellar magnitudes). Theoretical considerations are confirmed by actual calculations of expanding stellar models. The corresponding changes of structure consist of two components: (i) homologous changes, in which the release or absorption of gravitational energy is proportional to T/μ; (ii) pure changes of structure at constant potential energy, in which a certain energy of transition, w, is released in the central regions and absorbed in the outer regions, or vice versa. An approximate formula for w is given in terms of the variation of central density and temperature. Non-static changes of solar structure are suggested as a plausible cause of the recurrent ice ages on the earth. An increase in the circumcentral hydrogen content in the sun, produced by turbulence suddenly starting, may lead to an increased energy production and thus to a decreased luminosity. Other existing theories of quaternary climatic changes are briefly reviewed; it is shown that none of these is able to account for the observed size of the changes. A.

523.877

8459. On the spectral sequence of the stellar atmospheres. I–II. S. UENO. *Publ. Astron. Soc. Japan*, **1** (*No.* 3) 59–63 (1949); (*No.* 4) 138–54 (1950).

Equations are derived for the electron pressure and the number of effective atoms of various elements for each spectral type, assuming that the isothermal atmosphere above the photosphere and the opacity are due to the continuous absorption of negative H ions and of neutral H (according to papers by R. Wildt, 1939–42). The intensity distribution of the lines and its maxima within the spectral sequences, as well as the H-metal ratio, are discussed; explanations of anomalous H_γ maxima in terms of the negative H ion absorption are put forward. A. BEER

523.877

8460. A simple approximate solution for the radiation equilibrium of a "gray" atmosphere. D. LABS. *Z. Astrophys.*, **27** (*No.* 2) 153–5 (1950) *In German.*

523.877

8461. Pulsation properties of giant-star models. I. EPSTEIN. *Astrophys. J.*, **112**, 6–21 (*July*, 1950).

The pulsation equation is solved numerically for the fundamental and first-overtone modes for three giant-star models having very high central concentrations. The period/mean-density relationships derived from these integrations are practically identical with one another and are very similar to those derived in earlier investigations. It is found that the properties of the fundamental mode are determined largely by the physical conditions prevailing in the layers of the star around $r = (0{\cdot}7)R$. The properties of the first overtone are determined primarily by the conditions obtaining at $(0{\cdot}8)R$ and, to a lesser degree, by those around $(0{\cdot}5)R$. The pulsation periods were found to be little influenced by the conditions in the central regions of the star. Agreement between theory and observations with regard to the period-density relationship may be attained by: (1) reducing the cepheid masses, deduced from the empirical mass-luminosity relation, by a factor of about 4, or by (2) reducing the effective temperatures, estimated for the cepheids from their colours, by about 13%, or by (3) lengthening the theoretical periods by supposing that the H convection layer may have a depth of about one-fifth the stellar radius. A.

523.877

8462. Radiative equilibrium in an atmosphere in which pure scattering and pure absorption both play a role. A. D. CODE. *Astrophys. J.*, **112**, 22–47 (*July*, 1950).

In this paper a solution of the equation of transfer for an atmosphere in which both scattering by free electrons and pure absorption play a role is given. The laws of darkening, the temperature distribution and the degree of polarization for atmospheres with different values of $\lambda = \bar{\kappa}/\sigma + \bar{\kappa}$ are given for a grey atmosphere. The extension to cases of small departures from greyness is also considered. A perturbation theory for $\lambda \to 1$ is given, and it is found that accurate results for an atmosphere with an arbitrary λ may be obtained by linear interpolation between two different values of λ differing by 0·2. Finally, the laws of darkening and the degree of polarization in monochromatic light are considered. The degree of polarization decreases from short to long wavelengths. For a star whose effective temperature is of the order of 20 000°K, the polarization has reduced to about half the value of the integrated light at the ordinary photographic region for a star in which $\lambda = 0{\cdot}5$. The law of darkening at this wavelength is intermediate between that expected in a grey body and that in a pure scattering atmosphere. A.

523.877

8463. A note on energy generation. I. EPSTEIN. *Astrophys. J.*, **112**, 207–10 (*July*, 1950).

Generation rates are recomputed using new values of nuclear cross-sections for the C–N cycle [Abstr. 4341 (1950)], and a revised formula for the proton-proton reaction [Abstr. 4672 (1950)]. Preliminary calculations show that energy production by the p–p reaction is approx. 12× that by the C–N cycle

for the sun. Allowance for both energy sources should be made in calculating the luminosities of stars similar to the sun. The C–N cycle suffices for stars 2 mag. or more brighter than the sun.

R. A. NEWING

523.877

8464. On model atmospheres for high-temperature stars. A. B. UNDERHILL. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **25** (*No.* 13) 53 *pp.* (1950).

Opacity is assumed to arise from electron scattering and from continuous absorption by H and He, which are present in the ratio 85 : 15 by number. The Chandrasekhar mean absorption coefficient is used, and allowance is made for the effect of radiation pressure on mechanical equilibrium. The variation of temperature, pressure, etc., throughout the atmosphere is calculated, and the net flux is found to be approximately constant. The atmosphere becomes convectively unstable at about $\tau = 2{\cdot}00$, but large-scale disturbances are not expected. The line spectrum for the atmosphere is computed and compared with observed spectra. It is concluded that the model atmosphere has spectral type about O 9·5 V, the effective temperature being 36 800°. R. A. NEWING

523.877 : 517.392

Formulae for calculation of mean intensities and fluxes in a stellar atmosphere. *See Abstr.* 8421

523.877 : 538.615

8465. Zeeman shifts for stellar dipoles and quadrupoles with inclined axis. M. SCHWARZSCHILD. *Astrophys. J.*, **112**, 222 (*July*, 1950).

Formulae derived for the Zeeman shift in a magnetic star with inclined axis show that a quadrupole has to be, in general, $\sim 10\times$ the strength of a dipole to give the same measured effect in the integrated light. In the special case of no limb darkening, the former cannot be measured from any inclination.

D. L. EDWARDS

525.35 : 529.786

8466. On a periodic fluctuation in the length of the day. H. F. FINCH. *Mon. Not. Roy. Astron. Soc.*, **110** (*No.* 1) 3–14 (1950).

From a study of the performance of a number of quartz-crystal clocks employed in the Greenwich Time Service an annual periodic fluctuation in the length of the day is deduced. The variation is of the order of $\pm 0^s{\cdot}001$ and has an accumulative effec time of approximately $\pm 0^s{\cdot}060$. This is in close agreement with results obtained from in pendent data by N. Stoyko and demonstrates persistent character of the phenomenon.

525.35 : 551

8467. On the seasonal fluctuations of the rota of the terrestrial globe. F. H. VAN DEN DUNG J. F. COX AND J. VAN MIEGHEM. *Bull. Acad. R Belge. Cl. Sci.*, **36** (*No.* 5) 388–402 (1950) *In Frenc*

It is shown that the transfer of kinetic ene between the atmosphere and the earth is able to exp the seasonal fluctuations qualitatively and se quantitatively. M. W. OVEN

525.35 : 551.513 : 551.

8468. Variation in the earth's angular velo resulting from fluctuations in atmospheric and ocea circulation. W. H. MUNK AND R. L. MILL *Tellus*, **2**, 93–101 (*May*, 1950).

The seasonal component of angular velo anomalies has been computed from weather ma and is found to agree, with respect to magnitude phase, with anomalies first reported by Stokyo 1936 on the basis of astronomic observations. effects of fluctuations in the oceanic circulation, of shifting of air and water masses, have been estima to account for not more than 15% of the obser effect. The detection of shorter period fluctuation limited at present by the accuracy of astronomic t determination. The developments of an atomic cl and of the photographic zenith tube open the po bility of determining anomalies persisting for o 2 weeks, and of providing a new tool for obtaining index of integrated atmospheric circulation.

52

8469. On the calculation of long geodetics. J LEVALLOIS AND M. DUPUY. *Bull. Géod.* (*No.* 105–18 (*June*, 1950) *In French.*

Modern developments in the basic extension triangulation work (e.g. by radar methods, e suggested essential improvements of the mat matical solution of this problem, which have b worked out at the Institut Géographique National Paris. The outline of the new procedure and advantages are characterized and illustrated numerical examples. A. B

PHYSICS 53

53.081

8470. The MKS system and the tuition of physics. *Univ. Nac. Tucumán Publ.* (*No.* 492) 18 *pp.* (1950) *In Spanish.*

After a brief historical survey of the various systems of physical and electrotechnical units, especially the Giorgi system, first the mechanical and then the electrical units and their dimensions are discussed. Tables show the names, symbols, definitions, MKS units and their equivalent values in the cgs system. In the table showing the electrical units the equivale are given for the electrostatic and electromagne systems, for non-rationalized as well as for rationali units, the latter containing the coefficient 4π or inverse for the various quantities. The Giorgi syst uses as unit of energy the joule $= 10^7$ erg and as u of force the newton $= 10^5$ dyn. Any system sa fying the equation $2x + y = 7$, where 10^x cm is unit of length and 10^y g the unit of mass, gives 1 jo as the unit of energy. R. NEUMA

FUNDAMENTALS 530.1

530.1

8471. On the irreversibility of physical measurements in time and the representation of the fundamental concepts of mechanics. L. MOTCHANE. *C.R. Acad. Sci., Paris,* **231,** 36–8 (*July* 15, 1950) *In French.*

See also *ibid.*, **229,** 581–3 (*Sept.* 19, 1949). Existing mathematical methods are criticized as involving no intrinsic representation of the irreversibility of time. It is suggested that a more exact representation would imply both quantum and relativistic phenomena.

R. A. NEWING

530.1 : 53.081.6

8472. On the question of the fundamental [physical] constants. B. CLAUS. *Z. Phys.*, **127** (*No.* 5) 610–43 (1950) *In German.*

A number of dimensionless ratios between the various physical constants are derived, and it is shown, on the basis of measured values of the physical constants, that these ratios satisfy simple relations, such that any one ratio is determined by any other. It is therefore concluded that if any one such ratio is independent of time, all the others must also be time-independent. This leads to a discussion of difficulties with regard to the hypothesis that the radius of the universe (which enters into one of the above-mentioned dimensionless ratios) is increasing with time.

A. R. STOKES

530.112

8473. Matter, a mode of motion. The reflection of diverging waves by a gyrostatic medium. R. V. L. HARTLEY. *Bell Syst. Tech. J.*, **29,** 350–89 (*July*, 1950).

An attempt is made to show that an ether model, in which the elastic forces are of gyrostatic origin, can account qualitatively for relativistic and quantum phenomena. The model is shown to be capable of sustaining localized oscillatory disturbances which are interpreted as material particles. R. A. NEWING

530.131

8474. On a geometrical interpretation of energy and momentum conservation in atomic collisions and disintegration processes. J. BLATON. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **24** (*No.* 20) 30 *pp.* (1950).

The conservation laws are considered in their relativistic form for collision and disintegration processes in which two particles are present in both the initial and the final state. It is shown that the momenta and energies of the particles in the final state can be obtained with the aid of a certain prolate ellipsoid of revolution in momentum space. Applications to elastic scattering, nuclear reactions, photo-disintegration, the decay of mesons and the β-decay of nuclei are discussed. P. T. LANDSBERG

530.14

8475. The whirl theory of fundamental particles. N. S. JAPOLSKY. *Pakistan J. Sci. Res.*, 111–64 (*Oct.*, 1949).

A restatement of the author's attempt to account for quantum, relativistic and gravitational phenomena in terms of classical electrodynamics, photons and elementary particles being represented as rotating cylindrical waves. [See *Phil. Mag.*, **20,** 417–68, 641–706 (1935); **22,** 537–81 (1936)]. R. A. NEWING

530.145

8476. Problems of ambiguity in quantum field theory. Y. KATAYAMA. *Progr. Theor. Phys.*, **5,** 272–82 (*March–April*, 1950).

A general examination of whether a satisfactory field theory can exist. This must be free from ambiguities which arise if the matrix elements do not formally fulfil the requirements of gauge invariance, and equivalence and divergence theorems. The regulator method does not allow physically significant terms to be consistently separated from non-physical ones. The validity of the mathematically incorrect identity $\int L\delta''(q_\lambda^2 + L)dq = 0$ is examined and it is discussed at what point this procedure yields the results uniquely. Application to γ-decay of the neutral meson and decay of a τ-meson into 2 π-mesons.

J. JACOBS

530.145

8477. A convergent non-linear field theory. J. C. WARD. Letter in *Phys. Rev.*, **79,** 406 (*July* 15, 1950).

530.145

8478. Quantum field theory. H. S. SNYDER. *Phys. Rev.*, **79,** 520–5 (*Aug.* 1, 1950).

It is usually contended that the quantum theory of fields is intrinsically divergent. The present paper attempts to show that this divergence is due to the perturbation theory generally employed and not to the field theory itself. By means of a minor modification in the perturbation calculations, the divergent integrals may be given appropriate finite values. Although there are many apparent ambiguities in field theory, these are ambiguities of representation, and not ambiguities in physical content. The self-energy and stress of particles are zero. The expectation value of the energy momentum tensor for the true vacuum state is zero. From this point of view the polarization of the vacuum and charge renormalization seem to be factitious. A.

530.145

8479. On one possibility of constructing a generalized linear electrodynamics. V. S. MILIYANCHUK. *Dokl. Akad. Nauk, SSSR,* **71** (*No.* 5) 871–4 (1950) *In Russian.*

A generalized electrodynamic theory can be formulated which yields, for electrons at rest, the correct static potential, depending on $\exp(-a^2r^2)$; at large distances from the point charge the Coulomb potential holds. The possibility of pair production in the electromagnetic field is discussed; since such a virtual pair is most likely to occur near a singularity of the particle field the change in its field due to vacuum polarization will tend to remove the singularity. The field of the charged particle cannot be split into a field due to the "true" particle and one of the virtual pair. This removes the need for a displacement vector defining the position of the "actual" point charge. The impulsive energy tensor cannot satisfy Laue's theorem unless the electromagnetic field of the elementary particle is combined with that of its inert mass, similar to results of positron theory.

J. JACOBS

530.145

8480. Note on the self-energy and self-stress. II. K. SAWADA. *Progr. Theor. Phys.*, **5,** 236–51 (*March–April*, 1950).

Continuation [see Abstr. 7007 (1950)]. The self-

stress can be reduced to surface integrals in a 3-dimen. momentum space. For a fermion this is finite, if a polarization term is neglected, but this is not true for bosons, where the results depend on the surface, and on the mass. For the fermion a model to explain the stress can be given analogous to the Poincaré model in classical electrodynamics. The relation between the convergence of the self-energy and the vanishing of the self-stress is examined. For extended source models the convergence of the self-energy ensures the stability of the particle, whereas in the real-field subtraction models it does. For certain types of formal subtraction procedures the stability does not ensure convergence of the self-energy.

G. J. KYNCH

530.145

8481. Reflection properties of spin ½ fields and a universal Fermi-type interaction. C. N. YANG AND J. TIOMNO. *Phys. Rev.*, **79**, 495–8 (*Aug.* 1, 1950).

It is pointed out that four different transformations are possible under an inversion for fields of spin ½. The consequences are discussed, and the bearing on the possibility of a universal Fermi-type interaction is analysed. A.

530.145 : 530.162

8482. Statistical equilibrium and radiation damping. J. HAMILTON. *Proc. Phys. Soc., Lond. A*, **63**, 1036–40 (*Sept.*, 1950).

The reason why the usual form of radiation damping theory does not satisfy the principle of detailed balancing is discussed. A form of damping theory satisfying statistical equilibrium is developed. A.

530.145

8483. Theory of particles with high spins. E. S. FRADKIN. *J. Exp. Theor. Phys., USSR*, **20**, 27–38 (*Jan.*, 1950) *In Russian.*

An investigation is made of a method of obtaining equations in the spinor tensor form for particles with a given spin. A discussion is given of the one-value character of the equations and their decomposition in the absence of a field.

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530.145

8484. Angular wave functions of particles having a spin. V. B. BERESTETSKIĬ, A. Z. DOLGINOV AND K. A. TER-MARTIROSYAN. *J. Exp. Theor. Phys., USSR*, **20**, 527–37 (*June*, 1950) *In Russian.*

A general determination of spherical (L, 1) vector functions is given and the method of expanding the L-vector in terms of these functions is demonstrated. A number of examples, in particular the solution of Dirac's equation $\psi_{pl}(\bar{r})$ is considered, describing the movement of an electron of definite impulse and represented by a superposition of functions ψ_{jml}, corresponding to certain values of the angular moments. B. F. KRAUS

530.145 : 539.18

8485. Processes between light particles according to the Dirac theory. P. HAVAS AND B. KOCKEL. *Ann. Phys., Lpz.*, **7** (*No.* 7–8) 413–15 (1950) *In German.*

See Abstr. 5524 (1950).

530.145

8486. On the spin of the photon. G. MARX. *Hungar. Acta Phys.*, **1** (*No.* 6) 36–42 (1950) *In German.*

The fact well known in field theories that the spin component of the photon can have the values ± but not 0, is here deduced by treating Maxwe equations with the same method employed equations describing particles. The spin operato $-i\hbar\tau_k$, where $\tau_i\tau_k - \tau_k\tau_i = -\tau_l$ and $\tau_k\tau_4$ $\tau_4\tau_k = \tau_k$. The eigenvalue 0 corresponds to static field. L. PINCHER

530.1

8487. On the magnetic moment of the meson. V. S. VRKLJAN. *Proc. Indian Acad. Sci., A*, **31**, 32 (*May*, 1950) *In German.*

It is shown how this can be calculated more simp than in a previous paper [Abstr. 7743 (1950)] deriving the de Broglie wave-functions $\Psi_{l,m}$ direc from the equations set up for the meson by de Brogl W. J. SWIATEC

530.1

8488. Note on five-dimensional space and the se energy of the electron. Y. KATAYAMA AND S. TAKA Letter in *Progr. Theor. Phys.*, **5**, 336–8 (*March–Ap* 1950).

The theory developed in a previous paper [Abs 6243 (1950)] is modified by substituting the dimensional formalism suggested by Watanabe that due to Møller. Then the electron self-ener vanishes exactly. L. PINCHER

530.1

8489. Note on a possible annihilation process negative protons. J. ASHKIN, T. AUERBACH A R. MARSHAK. *Phys. Rev.*, **79**, 266–71 (*July* 15, 195

Expressions have been obtained for the annihilati cross-sections of proton pairs using weak coupli theory and spin zero mesons. The cross-section f annihilation into 2 charged mesons has a $1/v$ behavio in the limit of very small velocity, v, of the negati proton and dominates over the annihilation into photons. In the laboratory co-ordinate system it possible for one of the emitted mesons to emerge the backward direction with respect to the directi of the incident negative proton even for large incide energies. This may provide a method for d tinguishing high-energy annihilation events taki place in the cosmic radiation.

530.145 : 539.

8490. On the decay of heavy mesons. III. S. ÔNE S. SASAKI AND S. OZAKI. *Progr. Theor. Phys.*, 165–76 (*March–April*, 1950).

Previous results [see Abstr. 5517 (1950) and 70 (1950)] are extended to the γ-instability of t τ-meson. The Schwinger–Tomonaga formalism used. The γ-decay of a charged τ-meson is found be too short to be detected experimentally. Co parison with experimental results leads to a numb of selection rules for decay processes. L. PINCHER

530.1

8491. A note on the *C*-meson hypothesis. T. KIN SHITA. Letter in *Progr. Theor. Phys.*, **5**, 335–6 (*Marc April*, 1950).

A well-known device to make finite the 2nd-ord self-energy of an electron in the positron theory is assume that electrons are surrounded by a neut scalar meson field, the *C*-meson field, besides t ordinary e.m. field. In the present paper it is point out that the 4th-order self-energy, evaluated

Feynman's methods, diverges, suggesting that the success of the *C*-meson hypothesis in the 2nd-order approximation is only accidental. L. PINCHERLE

530.145

8492. On the extension of the theory of the Compton effect to mesonic fields. G. PETIAU. *C.R. Acad. Sci., Paris*, **231**, 119–22 (*July* 10, 1950) *In French.*

Expressions are derived for the meson Compton effect cross-sections where a meson C_0 is absorbed by a scattering particle and a second meson C_1 emitted in the cases when C_0 and C_1 are: (1) both pseudoscalar mesons: (2) both scalar; (3) pseudoscalar and vector; (4) scalar and vector; (5) vector and vector.

W. J. SWIATECKI

530.145

8493. Equivalence theorems for meson-nucleon couplings. E. J. KELLY. Letter in *Phys. Rev.*, **79**, 399–400 (*July* 15, 1950).

530.145

8494. On the use of β-formalism of the meson field for nuclear interactions. VACHASPATI. *Proc. Phys. Soc., Lond. A*, **63**, 1015–28 (*Sept.*, 1950).

Following a method due to Harish-Chandra, a correspondence between the Proca and the β-formalisms of the meson field theory is developed. An important feature of the method is that one can at any stage of calculations pass over from one formalism to the other. No explicit representation of the β-matrices is required nor need one know the exact relationship between the elements of the wave function ψ and the Proca field quantities U_μ and $G_{\mu\nu}$. This introduces considerable simplification in the introduction of nuclear interaction as compared with earlier treatments where one has to choose a special explicit representation of the β_μ's and identify the various elements of the matrix ψ with the components of U_μ and $G_{\mu\nu}$. The nuclear interaction is, in fact, here introduced very simply in an elegant way. The quantization is performed for the vector, scalar and pseudoscalar cases assuming in all cases both charge and dipole types of couplings. As an illustration of the method we calculate the scattering of positively charged mesons by protons. The spur calculations, so tedious in the earlier works, are now replaced by simple relations which are easily handled, and the results are obtained with about as much labour as is used in Proca's case with the additional advantage that both the longitudinal and the transverse parts of the meson field can here be treated together. A.

530.145

8495. Effect of assumed range of tensor force on the neutron-proton interaction. A. A. BROYLES AND M. H. HULL. *Phys. Rev.*, **79**, 247–57 (*July* 15, 1950).

In view of a suggestion by Breit that experimental deuteron properties might be realized without extreme modification of the central interaction by increasing the range of the tensor interaction, the problem was reinvestigated. For attractive central and tensor interactions it was found that the quadrupole moment can be accounted for by placing the shell beyond $r_1 = 0{\cdot}7(e^2/mc^2)$, and for a central field square well interaction of range either $r_0 = e^2/mc^2$ or $r_0 = e^2/2mc^2$ if the shell is placed at $r_1 = 1{\cdot}5(e^2/mc^2)$ the central field need be reduced by only about 2%. For a repulsive tensor interaction the quadrupole moment can be accounted for with $r_1 < 0{\cdot}7(e^2/mc^2)$ but the central interaction had to be increased by a factor of 4 for $r_0 = e^2/mc^2$. Investigation of neutron-proton scattering with interaction parameters determined by the deuteron quadrupole moment and binding energy shows that for the case of attractive interaction the zero-energy cross-section changes from 4·40 to 4·46 barns as r_1 changes from 1 to $1{\cdot}5(e^2/mc^2)$ when $r_0 = e^2/mc^2$ and from 3·94 to 3·62 barns when $r_0 = e^2/2mc^2$. For the case of repulsive tensor force with $r_0 = e^2/mc^2$, the zero-energy cross-section changes from 4·48 to 2·97 barns as r_1 changes from 0·56 to $0{\cdot}61(e^2/mc^2)$. It may be noted that this latter range includes the experimental value of the cross-section. The theoretical cross-section is smaller than experimental values for higher energies except for repulsive tensor force, and the anisotropy is only in qualitative agreement with the recent work at Berkeley. A.

530.145

8496. The effect of exclusion principle on the nucleon-nucleon scattering in nuclear matter. Y. YAMAGUCHI. Letter in *Progr. Theor. Phys.*, **5**, 332–3 (*March–April*, 1950).

A formula is given for the total scattering cross-section (valid under simplifying assumptions) for a nucleon moving through nuclear matter for energies including E less than $2E_F$ (E_F = Fermi energy). For E greater than $2E_F$ see Abstr. 1178 (1949).

W. J. SWIATECKI

530.145

8497. On charge independence and high energy scattering. R. JASTROW. Letter in *Phys. Rev.*, **79**, 389 (*July* 15, 1950).

It is shown that the difference between the high energy (32 MeV to about 350 MeV) p–p and n–p scattering as regards total cross-section and angular distribution can be accounted for semi-quantitatively without abandoning the Charge Independence hypothesis by assuming a strong repulsive force between nucleons at very small distances of approach. This force affects the n–p and p–p scattering differently because, in the latter case, the exclusion principle eliminates from the scattering certain not totally antisymmetric states. W. J. SWIATECKI

530.145 : 539.18

8498. Variational principles for scattering processes. I. B. A. LIPPMANN AND J. SCHWINGER. *Phys. Rev.*, **79**, 469–80 (*Aug.* 1, 1950).

A systematic treatment is presented of the application of variational principles to the quantum theory of scattering. Starting from the time-dependent theory, a pair of variational principles is provided for the approximate calculation of the unitary (collision) operator that describes the connection between the initial and final states of the system. An equivalent formulation of the theory is obtained by expressing the collision operator in terms of an Hermitian (reaction) operator; variational principles for the reaction operator follow. The time-independent theory, including variational principles for the operators now used to describe transitions, emerges from the time-dependent theory by restricting the discussion to stationary states. Specialization to the case of scattering by a central force field establishes the connection with the conventional phase shift analysis

and results in a variational principle for the phase shift. As an illustration, the results of Fermi and Breit on the scattering of slow neutrons by bound protons are deduced by variational methods. [See also Abstr. 8499 (1950)]. A.

530.145 : 539.18

8499. Variational principles for scattering processes. II. Scattering of slow neutrons by para-hydrogen. B. A. LIPPMANN. *Phys. Rev.*, **79**, 481–6 (*Aug.* 1, 1950).

Continuing the illustrative example of Abstr. 8498 (1950), the scattering of slow neutrons by two protons bound to a molecule is treated by variational methods. A numerical evaluation indicates that the Fermi approximation to the para-hydrogen cross-section is reliable to about 0·3%. A.

530.145

8500. Remarks on the variational method for scattering problems. L. HULTHÉN AND P. O. OLSSON. Letter in *Phys. Rev.*, **79**, 531–2 (*Aug.* 1, 1950).

See Abstr. 2926 (1950).

530.145

8501. Forced vibrations in quantum mechanics. M. M. ALPERIN. *J. Exp. Theor. Phys., USSR*, **20**, 62–4 (*Jan.*, 1950) *In Russian.*

A quantum mechanical examination has been made of the forced vibrations of a unidimensional oscillator. The question of the transfer of energy to the oscillator from an external system is discussed.

BROOKHAVEN GUIDE TO RUSSIAN LITERATURE

530.145

8502. On the relativistically improved integration in perturbation theory.—Its meaning in Feynman theory. H. UMEZAWA AND R. KAWABE. *Progr. Theor. Phys.*, **5**, 266–71 (*March–April*, 1950).

The new *w*-method retains relativistic covariance which is lost in the usual perturbation method applied to some problems of quantum field theory. The domain of integration is determined in a relativistically invariant way and hence the *w*-method can be introduced into Feynman theory. Results obtained with *w*-method in Feynman theory agree with those of *w*-method in the usual perturbation theory; the self-energy of an electron due to the neutral scalar meson and the electromagnetic self-energy of an electron are given as examples. J. JACOBS

530.145.6

8503. On the integrability condition in the "super-many-time theory." K. NISHIJIMA. *Progr. Theor. Phys.*, **5**, 187–95 (*March–April*, 1950).

In this theory there is a continuous infinity of wave equations. The integrability condition restricts then very drastically the possible forms of the interaction between fields. It is proved in the present paper that the law of conservation of energy-momentum holds only if the integrability condition is satisfied, thereby showing that this condition is necessary also for physical reasons. An application is made to the derivation of selection rules for decay processes.

L. PINCHERLE

530.162

8504. The Bose–Einstein condensation as a space phenomenon. I. R. BECKER. *Z. Phys.*, **128** (*No.* 1) 120–32 (1950) *In German.*

In contrast to the work of F. London, who considered condensation of a Bose–Einstein gas momentum space, this paper deals with the c densation in ordinary space. T. C. T

530.

8505. The condensation of ideal Bose gases a space phenomenon. II. G. LEIBFRIED. *Z. Phys.*, (*No.* 1) 133–43 (1950) *In German.*

A continuation of the work of paper I (preced Abstr.). T. C. T

530.

8506. On the notion of pressure in a canon ensemble. R. J. RIDDELL, JR. AND G. E. UHLENBE *J. Chem. Phys.*, **18**, 1066–9 (*Aug.*, 1950).

Recently a controversy has arisen between De B and Green [Abstr. 1551–2 (1950)] concerning notion of pressure in a canonical ensemble. Accord to Green, only classically is the pressure as deri from the partition function equal to that obtai from the virial theorem, while at low temperatu at which quantum effects become important, th will be considerable deviations between the t De Boer attempts to prove that the two pressures actually identical. The authors of this paper co to the same conclusion, and show this in sev ways. They believe that the discrepancy between two pressures which Green has found is in fact to improper handling of the effect of the wall of vessel in which the particles are contained. Fina they are of the opinion that Green's criticism De Boer's calculation is not justified, and in the section arguments are given to show that the tra of all commutators of interest in quantum statist mechanics are zero.

530.

8507. Remarks on a paper by Riddell and Uhlenbe H. S. GREEN. *J. Chem. Phys.*, **18**, 1123–4 (*Aug.*, 19

A reply to criticisms [preceding Abstr.].

530.

8508. On the Bose–Einstein condensation. S. DE GROOT, G. J. HOOYMAN AND C. A. TEN SELD *Proc. Roy. Soc., A*, **203**, 266–86 (*Sept.* 22, 1950).

The Bose–Einstein condensation of a gas is inve gated. Starting from the well-known formulae Bose statistics, the problem has been generalized include a variety of potential fields in which particles of the gas move, and the number w dimensions has not been restricted to 3. A di rigorous method is used similar to that proposed Fowler and Jones (1938). It is shown that the num $q = w/\alpha$ determines the appearance of an Einst transition temperature T_0. For $q \leqslant 1$ there is such point, while for $q > 1$ a transition point exi For $1 < q \leqslant 2$, the mean energy $\bar{\varepsilon}$ per particle the specific heat $d\bar{\varepsilon}/dT$ are continuous at $T =$ For $q > 2$, the specific heat is discontinuous $T = T_0$, giving rise to a λ-point. A well-defi transition point only appears for a very la (theoretically infinite) number N of particles. T finite only if the quantity $v = N/(a_1 \ldots a_w)^{2/}$ finite. For a rectangular box, v is equal to the m density of the gas. If v tends to zero or infinity $N \to \infty$, then T_0 likewise tends to zero or infi In the case $q > 1$, and at temperatures $T < T_0$, t is a finite fraction N_0/N of the particles, given

$N_0/N = 1 - (T/T_0)^q$, in the lowest state. London's formula (1938*b*) for the 3-dimensional box is an example of this equation. Some further results are also compared with those given by London's continuous spectrum approximation. A.

530.162 : 530.145 : 532.7

8509. On the quantum mechanics of fluids. P. J. PRICE. *Phil. Mag.*, **41**, 948–60 (*Sept.*, 1950).

This paper is principally a critique of the contribution by Green [Abstr. 3435 (1947), 2375 (1948)]. The relation of his formalism to wave-mechanics is discussed, and hydrodynamical equations are derived, in wave-mechanical form, which are shown to be equivalent to Green's results. A formula for the boundary stress is arrived at, and it is shown that the difference between the kinetic and thermodynamic pressures—on which Green's explanation of the thermomechanical effects in liquid helium II is based—is identically zero, confirming the conclusions of Yvon and de Boer. A.

530.162 : 531.396

8510. The many-body problem in quantized space-time. V. L. AVERBAKH AND B. V. MEDVEDEV. Letter in *J. Exp. Theor. Phys., USSR*, **20**, 92 (*Jan.*, 1950) *In Russian.*

530.162 : 541.183 : 536.71

Statistical theory of adsorption from regular solution. *See Abstr.* 9076

530.162 : 541.183 : 536.71

Statistical mechanics of adsorption. *See Abstr.* 9077

530.162 : 541.64

Statistical mechanics of dilute polymer solutions. II. *See Abstr.* 9083

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.252

8511. Nuclei of strain in the semi-infinite solid. R. D. MINDLIN AND D. H. CHENG. *J. Appl. Phys.*, **21**, 926–30 (*Sept.*, 1950).

Stress functions are given for forty nuclei of strain in the semi-infinite elastic solid. The corresponding stresses have the property that the traction vanishes across the plane boundary of the solid. The nuclei are derived, by processes of superposition, differentiation and integration, from the solution of the elasticity equations for the single force in the interior of the semi-infinite solid. A.

531.252

8512. Thermoelastic stress in the semi-infinite solid. R. D. MINDLIN AND D. H. CHENG. *J. Appl. Phys.*, **21**, 931–3 (*Sept.*, 1950).

The solution of the elasticity equations for the centre of dilatation in the semi-infinite solid is introduced into Goodier's theory of thermoelastic stress. It is shown that the problem of potential to be solved is identical with that for the solid of indefinite extent. The results are applied to the case of an expanding (or contracting) spherical inclusion embedded in an elastic body near its surface. A.

531.57 : 621.317.39

8513. Simple pressure-time-meters for ballistic processes. T. BONELL. *Tekn. Tidskr.*, **80**, 659–60 (*Aug.* 5, 1950) *In Swedish.*

The instrument, which records pressure as function of time, is based on a bridge method for measuring the change in resistance of a graphite element under varying pressure. It is used for ballistic investigations on small-arms and rockets, and is suitable for a time range from a few msecs to minutes. It is accurate and gives consistent results. The instrument is described and illustrated and examples of application are given. J. A. WILCKEN

531.571 : 536.46 : 541.126

8514. Symposium on kinetics of propellants. *J. Phys. Coll. Chem.*, **54**, 847–954 (*June*, 1950).

Concerned exclusively with solid propellants. The subjects covered are: mechanism and theory of combustion of double-base propellants; thermal theory of ignition of solid propellants; thermocouple determination of thermal structure of combustion wave [see Abstr. 8704 (1950)] and radiation effects in propellant burning. A. C. CLARKE

MECHANICAL MEASUREMENTS 531.7

531.7.07

8515. Single element verniers reading two or three dimensions. R. E. LEWIS. *Rev. Sci. Instrum.*, **21**, 647–9 (*July*, 1950).

By superimposing concentric radial elements on rectangular co-ordinate rulings, vernier systems may be constructed reading in 2 or 3 dimensions without the necessity of any particular angular orientation. A 2-dimensional vernier may consist of one transparent element ruled with concentric circles. The observed tangencies of the circles, with regard to a rectangular grid placed in contact, provide the reading of the additional decimal of the co-ordinates of the fiducial centre of the circles on the grid. A 3-dimensional vernier system may be established by means of a binocular optical system presenting images of spheres concentric with the locating point and images of co-ordinate boxes in the same space. The tangency of a vernier sphere and co-ordinate plane indicates the last decimal of the reading. Angular orientation may be indicated by radial lines near the points of tangency. A.

531.715.1 : 535.321

The determination of the index [refractive] and of the thickness of thin transparent films. *See Abstr.* 8598

531.717.1 : 539.165 : 620.179.1

8516. Non-contacting thickness gauge using beta rays. C. W. CLAPP AND S. BERNSTEIN. *Trans Amer. Inst. Elect. Engrs*, **69** (*Pt I*) 488–90 (1950).

For abstract see Abstr. 7039 (1950).

531.717.1 : 541.182.5

8517. A note on an apparatus for measuring the vertical swelling of colloid layers. E. J. LEWIS AND A. K. SOPER. *J. Sci. Instrum.*, **27**, 242–3 (*Sept.*, 1950).

The principle of measurement is based on the

theory of the parallel-plate viscometer, with water flowing between the gel surface and a parallel fixed plate. The apparatus is highly sensitive and rapid in action. A.

531.752

8518. Modification of Kilchling's method for a set of fixed positions of the torsion balance. J. PÍCHA. *Cas. Pěst. Mat. Fis.*, **75** (*No.* 2) *D*171–*D*177 (1950) *In Czech.*

Detailed development of the required formulae, which provide a check of the desired data after completion of a normal observation in 3 or 5 fixed positions. Two complete numerical examples are added. A. BEER

531.768 : 621.317.39

8519. The design and characteristics of a high sensitivity direct current operated accelerometer. R. C. LEWIS. *J. Acoust. Soc. Amer.*, **22**, 357–61 (*May*, 1950).

Uses a R.C.A. 5734 triode as the pick-up element, a weight being added to the externally projecting anode to add inertia. Movement of the weight relative to the containing case alters the internal position of the anode relative to the cathode, modulating the output of the valve, which is diode-connected and d.c. fed. The relationship of acceleration, sensitivity and natural frequency is examined mathematically, the range of a typical unit being 5–100 g, 0·1–10 V output, 80–600 c/s. Normal units are adjusted to give a certain standard performance, are very stable and reliable with reasonable linearity. Different couplings to the amplifier are possible and the valve may be used as a carrier amplifier or as a self-oscillator if d.c. operation is not desired.

E. D. HART (R)

531.775 : 621.317.39

8520. An electronic tachometer. H. G. JERRARD AND S. W. PUNNETT. *J. Sci. Instrum.*, **27**, 244–5 (*Sept.*, 1950).

Details are given of an instrument capable of measuring speeds of revolution of a shaft to an accuracy of $\pm 0{\cdot}05\%$. The rotation of the shaft is made to generate an alternating voltage which, after amplification, is connected to the Y-plates of a cathode-ray tube. The X-plates are connected to the output of a variable-frequency oscillator calibrated to $\pm 0{\cdot}05\%$ so that the trace appearing on the tube is a Lissajous figure. If the oscillator frequency is adjusted to give a stationary, easily identifiable Lissajous figure, then the unknown frequency is immediately known and the shaft speed given directly. Two methods by which the alternating voltage may be generated are described. Photographs show typical traces and the wave-form of the generator output. The instrument can cover any speed range. A.

MECHANICS OF FLUIDS 532

532.12 : 534.222.2

8521. The equation of state of water at high pressures, from X-ray flash photographs of intense shock waves. R. SCHALL. *Z. angew. Phys.*, **2** (*No.* 252–4 (1950) *In German.*

Shock-wave velocities up to 6 600 m/sec impulsive pressures up to 190 000 atm. are attai in water by means of an explosive charge. velocity of an advancing shock wave is observed a function of position, and the density variations deduced from X-ray photographs (exposure t $2–3\times10^{-7}$ sec). The pressure-density relation high pressures is then calculated. J. G. OLDR

532.13 : 536

8522. Temperature-dependence of the viscosity liquefied nitrogen and argon at constant dens B. I. VERKIN AND N. S. RUDENKO. *J. Exp. Th Phys., USSR*, **20**, 523–6 (*June*, 1950) *In Russian.*

The viscosity of elementary liquids, measured constant density, depends considerably on te perature. This experimental fact contradicts empirical relation $\phi = 1/\eta = (v - \omega)/c$ given A. I. Bachinskii, in which ω and c do not depend temperature. The formula only agrees with exp mental facts, if ω is considered as depending temperature. The temperature relation of the liq at constant density is the less marked, the nearer density is to its critical value. The temperat coefficients of N and A change sign within the crit range of density. The curve of viscosity v. te perature for a density $\rho > \rho_{cr}$ shows a steady variat at the passage through the critical temperature. mechanism of the temperature variation of viscosity in a liquid is thus absolutely identical w the corresponding temperature relation of viscosity of a gas compressed to a density $\rho > \rho_{cr}$.

B. F. KR

532.13 : 539.

8523. Note on the use of Reiner's equation for rec nition of pseudoplastics from their flow curves. V. KRAKAUER. *J. Appl. Phys.*, **21**, 850–2 (*Sept.*, 1950)

532.

8524. Stability of viscous flow over concave cy drical surfaces. D. MEKSYN. *Proc. Roy. Soc.*, **203**, 253–65 (*Sept.* 22, 1950).

This is investigated by the method of asympt solutions. The results confirm Gortler's conclusi that these disturbances can only take place on conc surfaces, and that in the critical condition that parameter $R_\delta(\delta/r)^{\frac{1}{2}}$ remains constant, where R_δ Reynolds number and δ/r is the ratio of the thickn of the boundary layer to the radius of curvat Additionally, it is found that there are many ste states, and the values of $R_\delta(\delta/r)^{\frac{1}{2}}$ are evaluated the first two states. For a fixed $R_\delta(\delta/r)^{\frac{1}{2}}$ there finite number of steady states.

532.51

8525. The eddy viscosity in turbulent shear fl A. A. TOWNSEND. *Phil. Mag.*, **41**, 890–906 (*Se* 1950).

532.517.4 : 536

8526. A study on heat transfer in turbulent flow pipe. S. TAKATSU. *J. Soc. Appl. Mech. Japan* (*No.* 16) 76–81 (1950) *In Japanese.*

The turbulent viscosity of flow which governs H transfer is examined, taking into consideration

existence of a viscous layer along the pipe wall; the mechanism of heat transfer is analysed theoretically on the basis of the analogy between heat transfer and skin friction; the heat transfer number in turbulent flow is obtained. A.

532.525 : 534.321.9

H_2 jets sensitive to ultrasonics. *See Abstr.* 8579

532.526

8527. The stability of the laminar boundary layer in a compressible fluid. L. Lees. *Rep. Nat. Adv. Comm. Aero., Wash.* (*No.* 876) 47 *pp.* (1947).

532.528

8528. Wall effects in cavity flow. I. G. Birkhoff, M. Plesset and N. Simmons. *Quart. Appl. Math.*, **8**, 151–68 (*July*, 1950).

For high-speed flow of a liquid past a solid, a cavitation parameter is defined as $Q = K = (p_f - p_c)/\frac{1}{2}\rho v_f^2$, where p_f is free stream pressure, v_f is free stream velocity, and p_c is the cavity pressure. A blocking constant below which the value of K cannot fall is deduced for flow in a tunnel with fixed walls. New formulae for flow in tunnels, open jets, and jets from an orifice are derived using the technique of conformal transformation. It is believed that these formulae form a simpler basis for numerical calculation than those previously used. Numerical results are evaluated for plates in conjunction with tunnels and open jets, and are shown graphically. E. H. DOCK

532.528 : 534.321.9

8529. Cavitation produced by ultrasonics. B. E. Noltingk and E. A. Neppiras. *Proc. Phys. Soc., Lond. B*, **63**, 674–85 (*Sept.*, 1950).

The problem of cavitation produced by ultrasonic vibration is examined theoretically. Equations are developed which describe the motion of a gas-filled cavitation bubble in a liquid medium subjected to alternating pressure; the case of an empty cavity is also considered. Information is obtained concerning the distribution of fluid pressures and velocities in the medium near the bubble surface during the motion. It is suggested that these theoretical conclusions may be used to show how the intensity of the various effects of cavitation will depend on ultrasonic frequency and intensity. In particular, it is predicted that all cavitation phenomena will diminish and finally disappear as the frequency is raised. The important part played by the nuclei from which the cavitation bubbles grow is emphasized. A.

532.542.3 : 533.6.011

8530. The critical Reynolds number for circular pipes from entropy considerations. E. Maurer. *Z. Phys.*, **126** (*No.* 6) 522–32 (1949) *In German.*

A comparison is made of laminar and turbulent flow through a pipe, of the same (almost) incompressible liquid with the same mean velocity and inlet conditions. The entropy is calculated in each case at a section remote from the ends, under conditions when the thermal insulation at the pipe wall allows the axial temperature gradient to be neglected. A critical Reynolds number ($R = R_0 \simeq 1400$) exists, at which the pressure gradients in laminar and turbulent flow are equal. If $R < R_0$, the laminar stream has the greater entropy; if $R > R_0$, the turbulent stream. The theory is approximately true also in the case of an ideal gas, provided that certain kinetic-energy terms can be neglected. J. G. OLDROYD

532.574.6

8531. Hot wire anemometry. G. B. Middlebrook and E. L. Piret. *Industr. Engng Chem.*, **42**, 1511–13 (*Aug.*, 1950).

A hot wire anemometer can be successfully used to measure very low water velocities. Electrolysis is responsible for many of the difficulties encountered in operating a hot wire anemometer in water. An insulating coating can be used to eliminate electrolysis but a short wire is a simpler solution to the problem. A.

532.58 : 534.222.2

8532. The determination of pressure on curved bodies behind shocks. T. Y. Thomas. *Commun. Pure Appl. Math.*, **3**, 103–32 (*June*, 1950).

Analysis of the pressure along the boundary of a curved, cylindrical obstacle behind an attached shock wave. It is assumed that the inclination of the boundary of the obstacle is a monotonic function of the arc length; when a similar behaviour of the inclination of the stream-lines at the boundary may be expected and the pressure in the flow near the boundary may be represented by a function in which the entropy is the parameter fixing the stream line. Since changes in entropy are small within the flow, a sufficiently accurate representation of the flow in the neighbourhood of an obstacle can be obtained. A differential equation of finite order for the nth approximation of the pressure on the boundary is obtained. Explicit solutions for the 1st, 2nd and 3rd approximations are given. L. J. GOODLET

532.593 : 532.517.4

8533. The effect of eddy viscosity on ocean waves. K. F. Bowden. *Phil. Mag.*, **41**, 907–17 (*Sept.*, 1950).

The effect of turbulence on ocean waves appears to call for an eddy viscosity which, while being large compared with the molecular viscosity, is small compared with the eddy viscosity found to apply to currents. It is proposed that the coefficient of eddy viscosity N, applicable to waves, should be of the form $N = Kca$, where c is the speed of propagation, a is the amplitude and K is a constant. With K of the order of 5×10^{-5}, the eddy viscosity would be large enough to account entirely for the observed rate of decay of ocean swell, while its effect on the attenuation of waves with depth would still be negligible. In the initial formation of waves, only the molecular viscosity need be considered. A possible effect of eddy viscosity on waves in the generating area would be to limit the steepness of the longer waves to a value less than the breaking steepness, even when the duration and fetch were unlimited. A.

CAPILLARITY 532.6

532.61.08 : 532.69 : 541.18

8534. Fundamental studies on interfacial tensions in flotation. I. M. Wada. *Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, **1**, 121–31 (*Aug.*, 1949).

The design and performance of a du Nouy tensio-

meter are described. The variation of surface tension with concentration was found to follow the Szyszkovski equation [*Z. Phys. Chem.*, **64**, 385 (1908)]. R. F. BARROW

532.62 : 532.72

8535. Study of the desorption of surface layers at constant pressure. L. SHARAGA. *C.R. Acad. Sci., Paris*, **231**, 46–8 (*July* 3, 1950) *In French.*

For a film of lauric acid on N/100 HCl, equilibrium always exists between the film and the layer of solution immediately below, and diffusion, which governs the desorption, is shown directly to take place within a zone of calm liquid under the film. R. H. DAVIES

532.694.1

8536. The inhibition of foaming. S. ROSS. *Rensselaer Polytech. Inst. Bull., Engng Sci. Ser.* (*No.* 63) 40 *pp.* (1950).

A connected and expanded account of work on antifoaming agents carried out during the war in Stanford University. Most of the results have already appeared in various journals. Experimental results of the effect of antifoaming agents on various foams lead to general theories of the mechanism involved. This is followed by a collection of information about chemical antifoam agents used in industry. J. IBALL

532.696.1

8537. Tensiometric study of the wetting power of solutions. J. GUASTALLA, L. P. GUASTALLA, D. LUZZATI, H. L. ROSANO AND L. SHARAGA. *C.R. Acad. Sci., Paris*, **231**, 220–2 (*July* 17, 1950) *In French.*

The adhesion tension between solid and liquid is measured by observing the pull on a plate dipping into the liquid. Paraffin-covered slides and solutions of fatty acids, soaps and some industrial wetting agents have been investigated and the value of the pull compared with that of pure water. Simultaneously measurements are made of the surface tension of the solutions (with a hydrophilic plate dipping into them). If τ_1, τ_0 are the measurements on the paraffined plate in solution and pure water and γ_1, γ_0 those on the hydrophilic plate in solution and pure water respectively then $\tau_1 - \tau_0 = p_1$ and $\gamma_1 - \gamma_0 = p$. It is found that the differences $p_1 - p$ are considerable and are related to the type of solute. J. IBALL

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 530.145.6 : 530.162

The quantum mechanics of fluids. *See Abstr.* 8509

532.7 : 530.162

8538. Radial distribution functions and the equation of state of a fluid composed of rigid spherical molecules. J. G. KIRKWOOD, E. K. MAUN AND B. J. ALDER. *J. Chem. Phys.*, **18**, 1040–7 (*Aug.*, 1950).

The integral equation for the radial distribution function of a fluid of rigid spherical molecules has been integrated numerically in the Kirkwood approximation and in the Born–Green approximation over a wide range of densities. The distribution functions so obtained have been used to calculate the equation of state and excess entropy of the fluid. The results compared with those obtained by means of the volume theory of the liquid state.

532.7 : 530.

8539. A new method for determining the ra distribution function. K.-C. CHENG. *Proc. Phys. S Lond. A*, **63**, 1028–36 (*Sept.*, 1950).

It is shown in this paper that Green's inte equation resulting from the Kirkwood approximat for the radial distribution function can be transfor into a differential equation of infinite order, to wh the method of successive approximation can applied without ambiguity. The solution at moo ately high temperatures is discussed. The result correction to the usual Boltzmann distribut function; the radial distribution function oscill with decreasing amplitudes at small distances tends to unity at large distances. The validity of approximations is discussed in two appendices.

532.73 : 536.753 : 541

8540. High polymer solutions. I. Vapour press of polystyrene solutions. C. E. H. BAWN, R. F FREEMAN AND A. R. KAMALIDDIN. *Trans Fara Soc.*, **46**, 677–84 (*Aug.*, 1950).

Measurements have been made of the vapour pr sure of polystyrene solutions in toluene and met ethyl ketone at different temperatures. The heat dilution of polystyrene by toluene is zero. The res are discussed in relation to the existing theories of free energy and entropy of dilution of polymers.

532.73

8541. The solubility of iron in mercury at 25–70 A. L. MARSHALL, L. F. EPSTEIN AND F. J. NORT *J. Amer. Chem. Soc.*, **72**, 3514–15 (*Aug.*, 1950).

MECHANICS OF GASES 533

533

8542. Effect of a magnetic field on transport phe mena in gases (diffusion). H. SENFTLEBEN H. SCHULT. *Ann. Phys., Lpz.*, **7** (*No.* 1–2) 10 (1950) *In German.*

Apparatus is described for the investigation of effect of a magnetic field on the diffusion of ga The concentration of the gases was determined measuring the resistance of a hot wire in the The apparatus was capable of measuring very sm changes of diffusion velocity. The effect of a m netic field on the diffusion of a diamagnetic through paramagnetic O_2 has been determined. a field of strength 10 000 gauss there is a relative crease of the diffusion coeff. for H_2–O_2 of appr mately 2×10^{-4}. This result agrees with th obtained earlier for the effect of a magnetic field the thermal conductivity and viscosity of gases, wh show that there is an increase in the effective cr section of the molecule in a magnetic field. A. J.

533

8543. On the theory of the Lorentz gas mixt L. WALDMANN. *Z. Naturforsch.*, **5a**, 322–7 (*J* 1950) *In German.*

In a Lorentz gas mixture (i.e. a mixture of m

heavy with few light molecules) with an arbitrary molecular interaction the following relation between the coefficient of interdiffusion D_{12}, the thermodiffusion coefficient α, the thermal conductivity of the mixture λ and of the pure heavy component λ_2 is derived: $\alpha = (\partial \ln D_{12}/\partial \ln T)_p - 2$; $\lambda = n_1 D_{12} k(5/2 + d(\alpha T)/dT) + \lambda_2$. ($T$ = temperature, p = pressure, n = particle density of the light component, k = Boltzmann constant.) For deriving the second relation it is necessary to know approximately the velocity distribution of the heavy component. It is shown that this is the same as it would be in the absence of the light component. H. LONDON

533.15

8544. A stationary method for determining diffusion coefficients. L. WALDMANN. *Z. Naturforsch.*, **5a**, 327–30 (*June*, 1950) *In German.*

The concentration difference of two parallel gas streams of different composition decays exponentially in the downstream direction. The temperature difference accompanying the diffusion (the diffusion thermoeffect) decays by the same law. From the decay length the diffusion constant can be calculated if the flow velocity is known. The method is demonstrated in an experiment with A/N_2. From the temperature dependence of the diffusion constant its relation to the coefficient of thermal diffusion (see preceding Abstr.) is roughly confirmed. H. LONDON

533.15

8545. The elementary theory of thermal diffusion. E. WHALLEY AND E. R. S. WINTER. *Trans Faraday Soc.*, **46**, 517–26 (*July*, 1950).

Fürth's elementary treatment of thermal diffusion has been applied to mixtures of elastic sphere gases with the help of certain simple assumptions concerning the transfer of momentum in collisions between dissimilar molecules. The results are in satisfactory agreement with the exact theory for elastic spheres except when the diameters and mass effects are in opposition with respect to thermal diffusion. In view of this agreement and the complexity of the exact theory of transport in multicomponent mixtures the elementary theory has been extended to such mixtures. The equations developed are comparatively simple and may be of value in a first analysis; they should give reasonable results if the masses and diameters act in the same direction. A.

533.15

8546. Diffusion and flow of gases and vapours through micropores. I. Slip flow and molecular streaming. P. C. CARMAN. *Proc. Roy. Soc.*, *A*, **203**, 55–74 (*Sept.* 7, 1950).

It has been shown that the slight minimum found by Knudsen in the plot of G against p for circular capillaries is very much exaggerated for non-circular cross-sections. Since the pore-system in a porous medium must correspond to non-circular sections, a similar minimum might be expected. Such a possibility would give rise to considerable uncertainty in applying gas permeabilities to the determination of specific surfaces of very fine powders, when flow takes place mainly by molecular streaming. It has been established clearly that, while the plot of G against p sometimes undergoes a small and very gradual change of gradient in the transition region, no sign of a minimum has been detected. For all practical purposes, it is sufficient to assume that G against p is linear for all values of p. The foregoing conclusions are not dependent on porosity or pore texture. The pore texture of fine powders at high porosities is so non-uniform that the surface calculated from permeability is 50% or less of its true value, but the transition from slip flow to streaming is unaffected and values of δ/k' are normal. A.

533.15

8547. Diffusion and flow of gases and vapours through micropores. II. Surface flow. P. C. CARMAN AND P. LE R. MALHERBE. *Proc. Roy. Soc.*, *A*, **203**, 165–78 (*Sept.* 22, 1950).

See also Abstr. 8546 (1950). Flow through porous plugs has been measured under conditions where surface flow of adsorbed gases makes an important contribution. An analysis of variables affecting surface flow enables surface diffusion coefficients to be calculated and has indicated conditions likely to reduce the correction for flow in the gaseous phase to small proportions. This has been confirmed by studying the effect of variations of porosity. Surface diffusion coefficients tend to increase with "coverage" of the adsorbent surface. This requires further study. Activation energies measured for one system were found to be rather small. Owing to the variation of surface diffusion coefficients with coverage, it proved difficult to obtain accurate values. Activation energies indicated a tendency to decrease as coverage increases. Further experiments on these points are also being carried out. A.

533.5

8548. A high speed expansion valve for cloud-chamber control. R. P. SHUTT AND W. L. WHITTEMORE. *Rev. Sci. Instrum.*, **21**, 643–6 (*July*, 1950).

A valve combining a number of principles not all used by others has been constructed. By balancing pressures the movable valve parts can be made very light despite a large valve opening, and the controlling electromagnet can be quite small. Calculations were made concerning all the important design features. Even a small electromagnet must be laminated to insure sufficiently fast decay of its magnetic field. Most of the remaining time delay is caused by the aerodynamic resistance at the valve opening. For a valve diameter of 5·6 cm expansions are completed in 8×10^{-3} sec. With a power consumption of 0·17 W a small vacuum tube is sufficient for operation. By balancing pressures one could construct a much larger valve operating as fast as the valve described with only a slight increase in power consumption. A.

533.5

8549. Glass variable microleaks for gases. J. J. HOPFIELD. Note in *Rev. Sci. Instrum.*, **21**, 671–2 (*July*, 1950).

533.5

8550. A convenient leak for testing helium leak detectors. G. H. JENKS. Note in *Rev. Sci. Instrum.*, **21**, 674 (*July*, 1950).

533.5 : 531.788.7

8551. A new vacuum gauge. R. HAVENS, R. KOLL AND H. LAGOW. *Rev. Sci. Instrum.*, **21**, 596–8 (*July*, 1950).

The gauge works on the principle of obtaining an a.c. signal from a normally d.c. pressure gauge by cyclically changing the pressure at a given frequency. In the model described, two bellows, one containing a Pt ribbon and the other a W wire, are connected to the vacuum by 1 mm holes, and driven by a motor to alter the pressure by 20% per cycle. The wires are heated by electric currents and the a.c. difference potential taken to an amplifier. The gauge is robust and covers a range of 1 atmos. to 10^{-5} mm Hg.

533.5 : 531.788.7

8552. Ultra-high vacuum ionization manometer. J. J. LANDER. Note in *Rev. Sci. Instrum.*, **21**, 672–3 (*July*, 1950).

533.5 : 531.788.7

8553. An all-metal ionization gauge. F. M. KELLY. Note in *Rev. Sci. Instrum.*, **21**, 673–4 (*July*, 1950).

533.56

8554. Characteristics of diffusion pumps. R. WITTY. *Brit. J. Appl. Phys.*, **1**, 232–7 (*Sept.*, 1950).

The essential characteristics of a diffusion pump are discussed, and apparatus and methods for determining them are described. The comparison of the performance of different pumps is discussed, and as an example experimental results are given for the relation between performance and gap width. Finally, theories of diffusion pump operation are discussed in the light of these experimental results and some future lines of experiment indicated. A.

533.58 : 537.565

8555. On the possibility of obtaining low pressures by gaseous ionization. R. CHAMPEIX. *C.R. Acad. Sci., Paris*, **231**, 40–2 (*July* 3, 1950) *In French.*

Describes a device in which the pressure in a vessel is lowered from the fore-vacuum value of 10^{-1} mm of Hg to 10^{-4} mm, by passing a high voltage discharge of the order of a few milliamps. It is suggested that the effect is produced by the removal of ionized molecules by the field of the discharge.

L. G. CARPENTER

533.583 : 621.385.032.46

8556. The getter action of thin barium films at low pressures. G. HAASE. *Z. angew. Phys.*, **2**, 188–91 (*April*, 1950) *In German.*

The getter action of Ba was studied at pressures $< 10^{-6}$ mm Hg. The Ba was prepared by 3 vacuum distillations, the last at 10^{-6} mm. It was loaded into a Ni tube in an A atmosphere. The test volume was sealed off with a liquid air trap between it and the seal-off so that no gas liberated during the operation could reach the test volume. The Ba was sometimes evaporated in high vacuum (10^{-7} mm) and sometimes in 8 mm A. The high vacuum films were active at room temperature, but the A films had to be cooled to liquid air temperature to obtain gettering action. The final pressures observed were the limiting reading of the radiometer gauge (about 10^{-8} mm).

A. H. W. BECK

533.583 : 621.385.032.

8557. A method for measuring the efficiency getters at low pressures. S. WAGENER. *Brit. J. App Phys.*, **1**, 225–31 (*Sept.*, 1950).

The measurement is based on ascertaining the dro in pressure along a narrow tube through which th gas to be absorbed by the getter is passed. Th pressures on either side of the tube are measured t means of ionization gauges. The values found fo the rate of gettering (of air) vary between 10 cm³/s for Mg and 1 500 cm³/sec for a Th getter. Th values depend on the position of the getter in th valve and increase with increasing proximity betwee the getter and the region in the valve in which the ga molecules are exposed to the impact of electrons.

533.6.011

8558. On the linearized theory of supersonic flow through axially symmetrical ducts. I. KOLODNE *Commun. Pure Appl. Math.*, **3**, 133–52 (*June*, 1950).

The flow of an inviscid, compressible fluid throug an axially symmetrical duct of slowly varying cross section at a constant supersonic velocity is analyse and a linearized theory set up for the determining duc function, giving the means and the conditions for th extension of a duct function defined over a bounde interval, also over an infinite interval, by means c Laplacian transformations. The solution is of us in the design of nozzles for parallel flow in the ex cross-section. Previous research is examined an compared, and a note appended on the application o the theory to 2-dimensional ducts. L. J. GOODLE

533.6.011.5 : 534.222.

8559. Studies with an aerodynamically instrumente shock tube. A. HERTZBERG AND A. KANTROWITZ *J. Appl. Phys.*, **21**, 874–8 (*Sept.*, 1950).

A shock tube has been set up at Cornell Universit to begin the study of 2-dimensional wave propagation Pressure waves initiated by the shock itself were use to trigger the spark source for the Schlieren flow observation system, to time the instant of exposur and to measure the strength (speed) of the shoc waves. These techniques were employed to study th propagation of a wave in a converging channel. Fai agreement between the one-dimensional method o characteristics and these experiments was obtained.

MOLECULAR THEORY OF GASES 533.7

533.7

8560. Electronic kinetic energy in gases at hig pressures. T. L. COTTRELL. Letter in *J. Chem. Phys* **18**, 1117 (*Aug.*, 1950).

533.7

8561. A discussion on the equations of stat H. RAMSDEN. *Mem. Manchr Lit. Phil. Soc.*, **9** 106–13 (1948–49).

Presents no new equation, but shows that for perfect or real gas it is preferable to use $(p + q)(v - b = RT$, and that experimental results are represente better by plotting $p + q$ against $v - b$, in conjunctio with a q, $v - b$ curve. C. TURNE

533.75

8562. On van der Waals' equation of state. B. GRUBER. *Čas. Pěst. Mat. Fis.*, **75** (*No.* 2) *D*187–*D*191 (1950) *In Czech.*

If the temperature T is lower than the critical temperature T_k the actual isothermal of a gas follows a horizontal line between certain points. In the paper it is shown that it is possible to express in 3 different ways the actual isothermal in the whole interval $(b, +\infty)$ by one arithmetical formula. A.

533.75

8563. The equation of state of gaseous He^3. J. DE BOER, J. VAN KRANENDONK AND K. COMPAAN. *Physica*, **16**, 545–54 (*June*, 1950).

A calculation is made of the 2nd virial coefficient of He^3, starting from the exact quantum mechanical expressions of this 2nd virial coefficient in terms of the intermolecular potential field and taking into account the symmetry effects (exchange effects or statistics) and the effects due to the spin of the He^3 nucleus. The intermolecular potential field which is used in the calculation, is identical with the field of He^4 molecules which was obtained from the 2nd virial coefficient of He^4 at high and low temperatures by de Boer and Michels [*Physica*, **5**, 945 (1938); **6**, 409 (1939)]. A.

533.75 : 533.24

8564. Gas theory and the equation of state. IX. J. DUCLAUX. *J. Phys. Radium*, **11**, 235–40 (*May*, 1950) *In French.*

The author explains briefly in this, the first of a series of papers dealing with the equation of state (and developing earlier work), the main principles of his theory of progressive association or condensation [Abstr. 3437 (1947)], and shows how the theory provides theoretical results in extremely close agreement with experimental data of Kammerlingh Onnes on the compressibility of oxygen at temperatures ranging from $+20°$ to $-116{\cdot}99°$. It is assumed that in all actual gases a fraction of the molecules is associated and that this fraction increases with increase of pressure and reduction of temperature. In order to simplify the calculations it is assumed that association occurs in a geometric series with ratio 2, 1, 2, that the "associated" molecules comprise 2, 4, 6, 8, $16 \ldots 2^n$ units. The theory finally leads to 3 equations, viz. $C_n^2 = K_{n,v}\, C_{n+1}$; $\log K_{n,v} = \log K_{0,1} + m \log v + n \log p$; $\log K_{0\text{-}0\cdot01} = 2{\cdot}9082 - 166{\cdot}2/T$, in which C denotes concentration, p is a constant parameter characterizing the gas, the parameter m depending upon temperature in a manner not yet established. The state of a gas at all temperatures is determined by 4 definite constants and one variable parameter. Compressibility and liquefaction are correlated, the liquefaction point being a singularity on the compressibility curve. Finally, a single curve suffices for the representation of compressibility and liquefaction at all temperatures. J. S. G. THOMAS

533.77

8565. The problem of the theory of steam. A. M. GUTKIN. *J. Exp. Theor. Phys.*, **20**, 538–46 (*June*, 1950) *In Russian.*

Theoretical investigations of saturated and superheated steam were made by a number of authors on the method of associations, according to which a vapour is considered as a mixture of very many gases. The component gases are so defined that the molecules of the first gas interact only singly among themselves, of the second gas only pairs of molecules with similar pairs, and so on. The molecule of the ith gas then consists of i vapour molecules, directly or by the intermediary of other molecules of the group interconnected with each other. The free energy of the steam and the number of molecules of each gas is found from the minimum condition of the free energy of the gas mixture. The authors give a method of calculating the specific volume of the steam molecules in two approximations. The relative influence of elastic and non-elastic collisions is estimated for the interaction of the molecules. The inconsistency of Band's steam theory is hereby demonstrated. B. F. KRAUS

533.822.9 : 537.531

An approach to X-ray microscopy. *See Abstr.* 8773

VIBRATIONS . ACOUSTICS 534

534.21 : 551.552

The fine structure of atmospheric turbulence and sound propagation. *See Abstr.* 9145

534.212

8566. Pulse propagation in two spacial dimensions. C. H. DIX. *Geophysics*, **15**, 447–55 (*July*, 1950).

The object is to clarify the physical picture involved. It is shown that for any initially given axially symmetric disturbance, confined between two concentric circular cylinders, if energy is subsequently transmitted outwards then it is also always subsequently transmitted inwards. The only possible case of no inward transmission is that of no transmission. Thus for a 2-dimensional pulse propagation every part of the pulse is being continually split at each instant, part travelling inwards and part outwards. Only the very simplest problem is solved in this paper. However, the process of tail (coda) formation is now clear for this case. A.

534.212

8567. The propagation of a sound pulse in the presence of a semi-infinite, open-ended channel. II. W. CHESTER. *Proc. Roy. Soc.*, *A*, **203**, 33–42 (*Sept.* 7, 1950).

Further investigation of a problem originally considered by the author [Abstr. 2258, 5617 (1950)] is carried out. The present paper discusses the asymptotic behaviour of the disturbance at large distances from the wave front. It is found that, for an incident Heaviside unit pulse, the wave inside the channel also tends to behave like a unit pulse, the correction term being $O(1/s)$ where s is the distance from the wave front. The asymptotic behaviour for an arbitrary incident pulse is also considered and illustrated with typical examples. The results are used to estimate the proportion of energy which returns along the channel when the incident pulse is of finite duration. A.

534.22

8568. Variation with temperature of the impact factor in a formula for the velocity of sound in fluids. D. SETTE. *Ric. Sci.*, **20,** 673–5 (*May*, 1950) *In Italian.*

The manner in which the "impact factor" of Schaaffs [Abstr. 3830 (1949)] varies with temperature in the case of organic liquids is shown. H. J. H. STARKS

534.222.2

8569. Theory of underwater explosion bubbles. B. FRIEDMAN. *Commun. Pure Appl. Math.*, **3,** 177–99 (*June*, 1950).

With the assumptions that (*a*) water is an ideal incompressible fluid, (*b*) the bubble remains spherical, and (*c*) the gas inside the bubble expands adiabatically, the motion of a bubble generated by an explosion is derived, taking account of the influence of the free surface and the bottom. Expressions for the period, the distance the centre moves during the first oscillation, the max. and min. radius of the bubble, the peak pressure of the wave emitted by the bubble and the energy left in the bubble after one or more oscillations are given and compared with experiment. Good agreement was obtained for the period. J. E. CAFFYN

534.222.2

8570. The experimental determination of the thickness of a shock front in a gas. G. R. COWAN AND D. F. HORNIG. *J. Chem. Phys.*, **18,** 1008–18 (*Aug.*, 1950).

Equations are developed from which the density profile of a shock front may be calculated from a knowledge of its reflectivity as a function of wavelength and angle of incidence. The reflectivities of shock fronts of shock pressure ratio $p_2/p_1 = 1{\cdot}71$ have been measured in N at initial pressure, p_1, equal to 85, 68 and 42 lb/in². From the change of reflectivity with wavelength, the thickness of the fronts was found to be $1{\cdot}8\times10^{-5}$ cm, $2{\cdot}0\times10^{-5}$ cm and $3{\cdot}2\times10^{-5}$ cm with an accuracy of 25%. An independent but less accurate check was provided by the change of reflectivity with initial pressure, yielding a thickness of $1{\cdot}5\times10^{-5}$ cm for $p_1 = 85$ lb/in². The weighted mean value, $1{\cdot}7\times10^{-5}$ cm, for $p_1 = 85$ lb/in² is significantly greater than that calculated from the theory of Thomas, $1{\cdot}0\times10^{-5}$ cm. A.

534.222.2 : 550.345

8571. Propagation of explosive sound in a liquid layer overlying a semi-infinite elastic solid. F. PRESS AND M. EWING. *Geophysics*, **15,** 426–46 (*July*, 1950).

The Perkeris theory of normal mode propagation of explosion sound in two liquid layers is extended to include the case of a solid bottom. Curves giving phase velocity, group velocity, amplitude, vertical pressure distribution as a function of frequency are presented. The relative merits of geophones and hydrophones for underwater seismology and the best depth for each type of instrument are discussed in the light of the theory. The characteristics of an incoming signal are described. A.

534.23

8572. Dispersion of sound in rarefied gases. M. KOHLER. *Abh. Braunsch. Wiss. Gesell.*, **2,** 104–8 (1950) *In German.*

Dispersion of sound in rarefied mono-atomic gases is calculated from a kinetical point of view, using the approximation of Burnett–Chapman. The resulting dispersion effect is greater by about 50–70% than the hydrodynamical dispersion by viscosity and conduction of heat. This effect is, in agreement with similar considerations of Wang Chang and Uhlenbeck, only slightly sensitive to changes of the model of molecule.

534.22

8573. Experiments with the Hartmann acoustic generator. L. E. SAVORY. *Engineering*, **170,** 99–100 (*Aug.* 4, 1950).

Details are given of the construction of a generator for use up to 18 kc/s, employing a nozzle and oscillator tube dia. of 0·125 in. Curves are given showing the variation of sound intensity and frequency with the depth of the oscillator tube at two different pressures. G. F. HODSMAN

534.22

8574. Experiments with the Hartmann acoustic generator. L. E. SAVORY. *Engineering*, **170,** 136–7 (*Aug.* 11, 1950).

Further tests are reported with the apparatus previously described [see Abstr. 8573 (1950)]. Regenerator pads and cylinders were placed in turn in the space between the nozzle and the oscillator, and different diameter stabilizing rods were placed in the air stream along its axial length. An increase in sound pressure was observed when the pads were used but not when the cylinders were used or, at low and pressures, when the stabilizing rods were used. The air flow was measured and the stabilizing rods were found to increase the efficiency of the generator, particularly at low pressures. The results are presented in tabular form. G. F. HODSMAN

534.232 : 535.3

8575. Transient radiation from sound sources and connected problems. J. BRILLOUIN. *Ann. Télécommun.*, **5,** 160–72 (*April*); 179–94 (*May*, 1950) *In French.*

Mathematical. The problem of progressive wave and the co-existence of a stationary field in a medium is reviewed with a survey of the framing of such a problem mathematically. Special note is made of the difficulties in the representation of discontinuities. General formulae are developed expressing the flux and the radiated and stationary energy densities: these are applied to examples. The discontinuities created at the front and the end of a wave-train are then treated and the results applied to a sinusoidal oscillator. The behaviour of a rigid sphere subjected to certain types of external forces is examined and the question of diffraction briefly treated with note of some practical consequences. A. J. KENNEDY

534.321 : 534.121

8576. Changes in pitch of bells. J. ARTS. Letter in *J. Acoust. Soc. Amer.*, **22,** 511–12 (*July*, 1950).

Results of experiments on two hemispherical bells, one dia. 11·9 cm, thickness 3·5 to 5 cm: other dia. 8·5 cm, thickness 2 cm. The lowest pitched note is produced by two components each with four nodal meridians: by applying a load at the antinodal meridian, or by cutting away metal at the four nodal meridians of the higher component, the frequency can be lowered so as to equal the lower frequency: then no beats occur. A change of pitch of carillon bells

may occur with time if after heating they have been quickly cooled. A bell-metal rectangular rod 232 × 15 × 45 mm had a fundamental frequency of 921 c/s. It was heated to 400°c, then quenched; the frequency became 844 c/s. From January 1949 the rod was exposed to indoor and outdoor temperatures; by April the frequency was 870 c/s; by October, 885 c/s. Bells made of iron did not show this change of frequency. If bell-metal objects are cooled sufficiently slowly after casting the pitch will not change during ordinary temperature variations. A. B. EASON

534.321.9

8577. Calculation of the focusing of ultrasonics. A. I. GUBANOV. *J. Tech. Phys, USSR*, **19** (*No.* 1) 30–3 (1949) *In Russian.*

534.321.9

8578. Ultrasonic interferometer with travelling wave. N. L. TELESNIN AND V. A. KRASILNIKOV. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 6) 1037–9 (1950) *In Russian.*

Alternative method of ultrasonic measurement, to that employing an interferometer utilizing standing waves, is described. In this method ultrasonic waves from a quartz oscillator are made to pass through a known liquid medium and are picked up by a piezo-electric receiver, whence they are fed—after amplification—on to one pair of deflecting plates of a C.R. oscillograph. The other pair of plates is connected direct to the quartz oscillator. The Lissajous figures obtained on the CRO screen depend on the position of the piezo-electric receiver, their variation providing the ultrasonic measurement. W. W. GEHR

534.321.9 : 532.528

Cavitation produced by ultrasonics. *See Abstr.* 8529

534.321.9 : 532.525

8579. H_2 jets sensitive to ultrasonics. M. DUBOIS. *C.R. Acad. Sci., Paris*, **231**, 217–18 (*July* 17, 1950) *In French.*

Jets from an orifice 0·192 mm dia. have been found sensitive to frequencies of 100 kc/s, 170 kc/s, 248 kc/s and 412 kc/s. The H_2 pressure used was 300 gm/cm² and the nozzle velocity 12 500 cm/sec. The vertical jet passed through a gauze above which it was lit, the oscillations of the flame being used to indicate the perturbations of the jet below the gauze. G. F. HODSMAN

534.321.9 : 535.824

8580. Method of microscope observation of preparations undergoing the action of ultrasound. F. A. LEVI. *Nuovo Cim.*, **7**, 271–3 (*May*, 1950) *In Italian.*

The author describes an experimental device by which it is possible to observe through a microscope a liquid suspension, while it undergoes the action of ultrasonic vibration. The liquid is in a small cell, into which the waves enter through a very thin wall and are reflected by a glass plate. In this way it is possible to obtain a particularly simple configuration of the ultrasonic field and an easier control of temperature. A.

534.321.9 : 541.14

8581. Theoretical explanation of the chemical effects of ultrasonics. V. GRIFFING. Letter in *J. Chem. Phys.*, **18**, 997–8 (*July*, 1950).

Water saturated with CCl_4 liberates Cl when irradiated with high-intensity ultrasonic waves, provided there is a gas dissolved in the water. At a given intensity the phenomenon occurs when the dissolved gas is He, N_2, O_2, Ne, A or Xe, but not if it is CO_2, N_2O, SF_6 or CCl_2F_2. To explain these results it is assumed that the dissolved gas forms minute bubbles. As the sound waves travel through these bubbles a large difference of temperature results from the adiabatic compression of the gas. A temperature gradient in the bubble is thus set up which produces appreciable periodic temperature variations in the liquid surrounding the bubble; these may be sufficient to cause decomposition. To explain why the presence of only certain gases is effective, the ratio of the specific heats, γ, is important. As the γ of the gas approaches that of the liquid the temperature reached becomes much lower. The thermal conductivity of the gas will determine how much the high gas temperature is passed on to the liquid. Experimental work carried out up to the present gives results which accord with these views. A. J. MEE

534.84

8582. Methods of overcoming acoustic coupling. W. BÜRCK. *Frequenz*, **4**, 161–6 (*July*, 1950) *In German.*

A review of patented methods for reducing or neutralizing the effects of acoustic coupling in public address equipment. H. J. H. STARKS

534.88 : 551.463

8583. Distribution of sound velocity in a section of the eastern North Pacific. E. R. ANDERSON. *Trans Amer. Geophys. Un.*, **31**, 221–8 (*April*, 1950).

Vertical and horizontal distribution of sound velocity have been obtained for the eastern North Pacific area from an analysis of the temperature and salinity data taken at 23 hydrographic stations. A method for extending the vertical sound velocity curves to the ocean bottom is suggested. Certain specific characteristics of the sound velocity distribution, such as the depth and velocity at the top, axis, and base of the sound channel are described. The relation of the various features of the area is discussed. Application of this information to the use of the deep sound channel in air-sea rescue (Sofar) is discussed. For several test explosions in the eastern North Pacific the position of the explosion was computed from the arrival times of the sound waves at each shore station. The computed positions were within a few miles of the navigated position of the ship which dropped the bombs. A.

OPTICS . RADIATION . SPECTRA 535

535 : 530.1

8584. An optical model of physics. M. HERZBERGER. *J. Opt. Soc. Amer.*, **40**, 424–9 (*July*, 1950).

Optics in the paper is considered as consisting of 3 layers: geometrical optics, which gives the geometry of the problem (straight lines equal light rays, spheres equal wave surfaces), diffraction optics, which considers a periodic disturbance of given frequency along selected light rays (a field), and the theory of emission

and absorption, which considers the selection of discrete frequencies. Physics can be built up parallel to it as optics in space-time. The geometry of physics based upon a variation principle contains general relativity as a special case; diffraction physics gives the laws of propagation of electromagnetic energy of all wavelengths in a well-defined field; and the theory of emission and absorption selects suitable frequencies. The paper describes in detail the laws of the first level and sketches the basic problems of diffraction physics. The problems of emission and absorption are only mentioned (Einstein effect) and will be treated in detail later on. Electricity and gravitation emerge in this theory as the physical equivalence of the fact that the field equations can be split into a symmetric and an antisymmetric part. A.

535.21

8585. Physical radiation detectors. Bibliographical information (period 1939–49). H. KÖNIG. *Rev. Opt. (Théor. Instrum.)* **29** (*No.* 8–9) 439–78 (1950) *In French.*

This bibliography of 498 entries has been compiled at the request of the International Optical Commission. It is presented in two arrangements: (*a*) In alphabetical order of authors' names, by year of publication. (*b*) By subject subdivisions, with occasional brief notes, under the following main headings: Phenomena; Photofiles; Photo-emissive cells; Thermal detectors; Other detectors; Sensitivity limits and their comparison (with table); Image transformers; Optical null methods; Electric apparatus, amplifiers. A note (2 pp.) entitled **Remarks on the use of physical detectors in optical instruments,** by A. ARNULF, is included.

535.214.4

8586. A 4π-radiometer. T. BENZINGER AND C. KITZINGER. *Rev. Sci. Instrum.*, **21,** 599–604 (*July*, 1950).

Total radiated heat loss and average surface temperature of living bodies have heretofore required laborious computation from numerous local measurements. The present study introduces the blackbody principle for this objective. Shieldless surface receivers have been designed, and built from identical and symmetrical sets of thermoelectric foil junctions, which were then made different only in their power to absorb or reflect radiation. By means of thermal shunting, they have been rendered stable against air motion up to 8 m/sec. A cavity, when uniformly lined with such receivers, will integrate the measurements of radiated output into every direction of space, permitting a direct recording of the total. The receivers have been developed specifically for application to the human gradient calorimeter now under construction. However, since the laws of radiation apply to cavities of any size or shape, the proper function of blackbody radiometry could be experimentally verified with a smaller number of receivers in a body of $8\times8\times16$ cu. in. The 4π-measurement is practically independent of location, size, or shape of the emittent source. The sensitivity is 76 μv/cal./sec. Full response is attained within 2·4 sec. A.

535.214.6

8587. Photophoresis of suspensions of coloured solutions in air, and their coefficients of absorption. F. DÉGUILLON. *C.R. Acad. Sci., Paris,* **231,** 274 (*July* 24, 1950) *In French.*

On illuminating a fibre of absorbing glass, placed i smoke, the smoke is repelled; this effect takes place addition to the convection to be expected. Differe colours of light show different effects, both as to sig and magnitude. It is suggested that unequal heatin of the suspended particles is the cause of the motio observed. N. CORCORA

535.

8588. The radiation constants and the light-equiv lent of energy. W. DE GROOT. Letter in *Physica,* 1 419–20 (*April*, 1950).

The discrepancies between the experimental an theoretical values of Planck's radiation constant an the total-radiation constant have been attributed inaccurate knowledge of the melting point of gol T_{Au}. This is supported here and a functional relatio is established between variations in T_{Au} and K, th light-equivalent of energy. T_{Au} must be a fe degrees higher than hitherto assumed. J. JACO

535.231

8589. The emission of radiation from nitric oxid approximate calculations. L. E. BENITEZ AND S. PENNER. *J. Appl. Phys.*, **21,** 907–8 (*Sept.*, 1950).

Emissivity calculations have been carried out f nitric oxide at temperatures from 300 to 3 000°K. T results may be used, as a first approximation, at el vated total pressures.

535.231

8590. The colour temperature of light source H. G. W. HARDING. *Proc. Phys. Soc., Lond. B,* 6 685–98 (*Sept.*, 1950).

The definition of colour temperature is explain and the approximations of the spectral distributions energy of lamps to those of black-body radiators a indicated. The value of colour-temperature measur ments to the colorimetrist is outlined and difficult in making the measurements are dealt with. The u of photoelectric devices for colour-temperatu measurements are mentioned.

535.241 : 551.593

8591. A comparison of visual and photoelectr measurements of the attenuation of brightness contra by the atmosphere. H. S. COLEMAN AND H. ROSENBERGER. *J. Opt. Soc. Amer.*, **40,** 371 (*June*, 1950).

The results of the comparison indicate excelle agreement between the atmospheric data obtained the two methods. It is concluded that if prop experimental techniques are followed, there is reason to expect visual photometry to lead to differe atmospheric attenuation data from those obtained photographic and by photo-electric processes.

535.245 : 778

8592. On the spectral energy distribution in t image on the ground glass screen of a sphere illum nated by the sun, the sky and reflex light. M. NAG *Optik*, **6** (*No.* 6) 348–75 (1950) *In German.*

Previous work on the following topics is brie reviewed: the spectral sensitivity of photograph emulsions, the spectrum of the sun seen throu varying thicknesses of air, the spectrum of sky li and the sum of sun and sky light, the effect of clou

and the light scattered by atmospheric particles. The importance of the u.v. limit of sunlight is stressed and data for u.v. reflection by various materials quoted. For formal calculation a white diffusing sphere is adopted, and the illumination at selected points on it determined from existing data for sun and sky light. The effect of providing a reflecting hemisphere below the sphere, corresponding to the background of normal objects, and having a reflection coeff. of arbitrary values between 0·05 and 1·0, is also calculated for both sun and sky light, hence finally the total illumination of points on the spherical object. The importance of varying ratios of sun to sky light is discussed with reference to the resulting colour of the light. Spectrum curves show the changes in one case as the ratio changes from 0 to ∞. The article is to be concluded later. S. T. HENDERSON

535.247.4 : 621.317.39

8593. Modulated-light densitometer. H. P. KALMUS AND M. SANDERS. *Electronics*, **23**, 84–7 (*July*, 1950).

This principle of light measurement avoids the need for d.c. amplification and reduces the average amount of light falling on the medium. A 6 V dial light is used as source and is sinusoidally modulated by a 20 c/s multivibrator synchronized at the 3rd subharmonic of the mains frequency. The lamp is included in the anode or cathode lead of a pentode biased to cut-off and driven from the multivibrator. The phototube, with a sensitivity of 20 μA/lumen, is terminated dynamically by a 25 MΩ resistor. It feeds into a 4-stage amplifier and thence to a rectifier and the indicating meter. A parallel-T network tuned to 120 c/s is inserted between the 1st and 2nd stages to eliminate modulation due to artificial lighting and another similar network tuned to 20 c/s is used as a degenerative feedback element across the 2nd stage to give a bandwidth < 1 c/s at the half-power points. The overall voltage gain of the amplifier is $1{\cdot}5 \times 10^5$. Full-scale deflection is obtainable with a light flux of 0·5 μlumen and the 98 db rejection at 120 c/s permits operation in an artificially lighted room. H. G. M. SPRATT

535.317

8594. The monocentric Schmidt–Cassegrain cameras. P. A. WAYMAN. *Proc. Phys. Soc., Lond. B*, **63**, 553–6 (*Aug.*, 1950).

Formulae are obtained for the leading coefficients in the plate-profile expansion of the monocentric Schmidt–Cassegrain cameras. These are used to derive expressions for the monochromatic and chromatic aberrations of the general monocentric system, and spot-diagrams are included to illustrate the image quality in a typical case. A comparison is made with an ordinary Schmidt camera, which has the same aperture and the same depth of figuring on the aspheric plate. A.

535.317.5

8595. Distortion as a function of the image position. H. SLEVOGT. *Optik*, **6** (*No.* 6) 321–6 (1950) *In German.*

Two stability criteria are derived from Gaussian optics for the distortion to be independent of the magnification of the system (Staeble's criterion) and also of the chosen image plane, this being of importance in photogrammetry. The theory is extended to include 3rd-order aberrations and two corresponding conditions obtained in terms of the Seidel coefficients. R. W. FISH

535.317.5

8596. Wave aberration and tolerances in spherical aberration. C. MORAIS AND A. MARTÍN-TESORERO. *An. Real. Soc. Esp. Fis. y Quim.*, **46A**, 231–8 (*July–Aug.*, 1950) *In Spanish.*

Theoretical. The relation, in its most general form, for the aberration of a luminous wave traversing an optical system affected by spherical aberration is derived, and the condition for maximum or minimum deduced. The theory is applied to systems of 3rd, 5th and 7th order and the tolerances calculated. S. WEINTROUB

535.317.6

8597. The computation of wave-front aberrations of oblique pencils in a symmetrical optical system. W. WEINSTEIN. *Proc. Phys. Soc., Lond. B*, **63**, 709–23 (*Sept.*, 1950).

Aberration formulae given previously, together with new ones for astigmatism and secondary spherical aberration, are put into forms which are suitable for computation and simplify the treatment of field lenses. A method of comparing the formulae with ray tracing is given, and the results for a triplet objective are discussed. A.

535.321 : 531.715.1

8598. The determination of the index [refractive] and of the thickness of thin transparent films. F. ABELÈS. *J. Phys. Radium*, **11**, 310–14 (*July*, 1950) *In French.*

Spectrophotometric methods are surveyed; although simple, they are not generally applicable, failing for thicknesses below $\lambda/4$. A new method is described for evaluation of refractive indices involving determination of reflectivities for two different wavelengths. The method is applied to evaluating the refractive index of TiO_2. For a particular film the reflectivity as a function of wavelength is given for the range $\lambda\lambda$400–7 500 Å. For a thickness of 19 mμ the index found is $2{\cdot}48$ for $5\,000 < \lambda < 6\,000$. Calculations are made for both normal and oblique incidence. Data are reported for MgF_2, CaF_2, LiF, cryolite and aluminium fluoride. Polarimetric methods are also discussed. The methods developed can also be applied to films on an opaque base. S. TOLANSKY

535.33

8599. Examples of spectrographic intensity measurements. J. A. SMIT. *Ned. T. Natuurkde*, **16**, 137–44 (*July*, 1950) *In Dutch.*

Observation of the intensity of lines and bands in a flame or arc spectrum can give information about the high temperature in the source of radiation, the transition probabilities of the lines and the concentrations of the gases and vapours present. The principles of this kind of spectrographic research and some sources of error are described. C. TURNER

535.33

8600. Complementary spectra. K. Miescher and R. Rometsch. Commun. in *Experientia*, **6**, 301–2 (*Aug.* 15, 1950).

535.33 : 537.212

8601. Influence of a nonhomogeneous electric field on the intensity of spectral lines. V. S. Miliyanchuk. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 1001–4 (1949) *In Russian.*

535.33.03 : 535.35 : 539.181

8602. Light excitation by collision of H and He atoms with alkali atoms. K. Gailer. *Z. Phys.*, **126**, (*No.* 6) 583–97 (1949) *In German.*

The light produced was spectrographed and numerous lines identified. These were from the arc spectra of Li and Na, and from arc and spark spectra of K, Rb and Cs. No emission from H or He was detected. The results do not fit Döpel's theory of the collision process [*Ann. Phys.*, **16** (*No.* 1) 1–36 (1933)], which requires excitation of the H or He spectrum in cases where both arc and spark lines of the other atom are produced. Collisions of the second kind may, however, cause the spark lines.

S. T. HENDERSON

535.33.03–15 : 536.46 : 541.126

8603. Notes on infra-red emission from CO–oxygen explosions. B. W. Bullock, C. A. Hornbeck and S. Silverman. Letter in *J. Chem. Phys.*, **18**, 1114–15 (*Aug.*, 1950).

535.33.072

8604. Simple variable space infra-red absorption cell. J. U. White. *Rev. Sci. Instrum.*, **21**, 629–30 (*July*, 1950).

A range of thicknesses from 5 mm to less than 10 μ makes the cell suitable for the compensation of absorption by solvents in a double beam spectrophotometer; its accuracy and reproducibility are sufficient for most direct qualitative and quantitative measurements. The minimum volume is approximately 1 cc, and the leakage is negligible. Its windows of rocksalt may easily be removed and repolished.

A.

535.331

8605. The low terms of Ti II. A. Many. Letter in *Phys. Rev.*, **79**, 531–2 (*Aug.* 1, 1950).

535.331 : 535.417

8606. Interference measurements in the spectra of neon and natural mercury. K. Burns, K. B. Adams and J. Longwell. *J. Opt. Soc. Amer.*, **40**, 339–44 (*June*, 1950).

Accepted Ne standards cover the region 6 929–5 852 Å. The first spectrum of Ne has been observed throughout the region 8 919–3 126 Å to assist in establishing secondary standards in that part of this range where none exist. The first spectrum of natural Hg was observed from 7 020 to 2 200 Å to discover in what part of this range standards of suitable intensity will be available when lines emitted by Hg^{198} have been measured; and to find out which lines (if any) of the natural element may serve as standards when Hg is accidentally or unavoidably present in a low pressure source. It is shown that some lines of natural Hg are suitable for secondary standards, and nearly all may be useful when an accuracy of no mor than a part per million is required.

535.331 : 535.41

8607. Interferometric measurements of wave-length in the spectrum of mercury isotope 198. J. M. Blank *J. Opt. Soc. Amer.*, **49**, 345–6 (*June*, 1950).

Six lines in the spectrum of Hg^{198} in the rang 5 790 to 3 650 Å have been measured with Fabry–Perc etalons. The wavelengths obtained were 5 790·662 5 769·5984, 5 460·7531, 4 358·3376, 4 046·5716 an 3 650·1569 Å. These results are compared with thos previously reported.

535.33

8608. Perturbations in the infra-red bands of SrC G. Almkvist and A. Lagerqvist. *Ark. Fys.*, 2 *Paper* 23, 233–51 (1950).

Study of the perturbations in the $^1\Sigma^* - {}^1\Sigma$ syster [Abstr. 1629 (1950)] has led to improved values c the vibrational constants of $^1\Sigma^*$, and values of th vibrational and rotational constants of 4 perturbin states or sub-states have been derived. R. F. BARROW

535.338.33

8609. Isotope shift in the Cd I resonance lin λ3261 Å. P. Brix and A. Steudel. *Z. Phys.*, 12 (*No.* 2) 260–8 (1950) *In German.*

λ3261 Å, Cd I ($5s^2\ {}^1S_0 - 5s5p\ {}^3P_1$) shows an iso tope shift in absorption. The source of radiation i six atomic beams generated together in the sam furnace, one behind the other. The displacement i $0(Cd^{114}); +13{\cdot}5(Cd^{112}); +29{\cdot}5(Cd^{110})\ (\times 10^{-3}\ cm^{-1})$ This can be explained as a nuclear volume effec [cf. H. Schüler, Abstr. 3554 (1933)]. The experi mental isotope shift constant (Cd^{112}–Cd^{114}) is cal culated as $(34 \pm 4) \times 10^{-3}\ cm^{-1}$. The uneve isotopes show an overall splitting of 214×10^{-3} cm coming from the $^3P_1$-state (controlled with λ4800 Å and their centre of gravity is shifted with respect t the even isotopes $(8 \pm 3) \times 10^{-3}\ cm^{-1}$ to the viole side.

C. TURNE

535.338.

8610. Study of certain singlet systems of the nitroge molecule. J. Janin. *J. Rech. Cent. Nat. Rech. Sc* (*No.* 12) 156–63 (1950) *In French.*

Rotational analysis and detailed identification o levels from spectra [see Abstr. 1491 (1948)].

D. H. WHIFFE

535.338.

8611. On the identification of the 3 670 A band o the C_2 molecule. J. G. Phillips. *Astrophys. J.*, **112** 131–5 (*July*, 1950).

By means of a rotational analysis of the 3 670 band, it is shown that the lower state is the $v'' =$ vibrational level of the $^1\Pi_u$ state of C_2. The identifica tion of the upper state is uncertain, but it is mos probably the $v' = 7$ vibrational level of the $^1\Pi_g$ state It is found that the $^1\Pi_g$ state undergoes a stron vibrational perturbation. The presence of such perturbation will affect the dissociation energy of th $^1\Pi_g$ state derived by a Birge–Sponer extrapolation.

535.338.

8612. On the transition probabilities of C_2 Swa bands. N. R. Tawde and J. M. Patel. *Astrophys. J* **112**, 210–12 (*July*, 1950).

Tabular comparison of theoretical probabilities b

McKellar and Buscombe with those of Patel computed from the same formulae of Hutchisson show considerable differences, but the latter are confirmed. These are used to examine flame intensities measured by Patel under 10 varied conditions. Departures from theory, which increase for bands of higher vibrational quanta, are attributed to the anharmonic nature of the nuclear oscillations. Details will be given in a future paper. D. L. EDWARDS

535.338.4

8613. Intensity distribution in band-systems of O_2 and O_2^+. M. E. PILLOW. *Proc. Phys. Soc., Lond. A*, **63**, 940–52 (*Sept.*, 1950).

The intensity distributions for the Schumann–Runge and Herzberg systems of O_2 and the second negative system of O_2^+, are calculated, and compared where possible with experimental results. Some suggested identifications of bands observed in emission from the night sky are checked by comparison with the calculations. A.

535.338.4–31

8614. Ultra-violet bands of K_2. S. P. SINHA. *Proc. Phys. Soc., Lond. A*, **63**, 952–6 (*Sept.*, 1950).

Bands of K_2 have been photographed in absorption in the region λ3924–λ3420 Å. They lie in two groups, one between λ3924 and λ3686 Å and the other between λ3640 and λ3420 Å, and appear to belong to two different systems. The bands in the first group have been analysed. They can be represented by the equation: $\nu = 26\,493{\cdot}0 + 60{\cdot}6u' - 0{\cdot}15u'^2 - 92{\cdot}64u'' + 0{\cdot}354u''^2$, where $u = v + \frac{1}{2}$. The upper state of this system is considered to dissociate into $4^2S + 5^2P$ atoms of K. No analysis for the bands lying between λ3640 and λ2430 Å has been possible. A.

535.338.4–31

8615. A new ultra-violet band-system of GeBr. E. B. ANDREWS AND R. F. BARROW. *Proc. Phys. Soc., Lond. A*, **63**, 957–9 (*Sept.*, 1950).

The vibrational analysis of the new system gives constants (in cm^{-1}):

	ν_e	ω_e	$x_e\omega_e$
$^2\Delta$ or $^2\Pi$	27 252	$197{\cdot}_3$	$7{\cdot}_{18}$
	27 156	$190{\cdot}_1$	$7{\cdot}_{25}$
$^2\Pi_{3/2}$	1 150	$295{\cdot}_4$	$0{\cdot}7_2$
$^2\Pi_{1/2}$	0		

The upper state, probably $^2\Delta$ or $^2\Pi$, appears to converge rather rapidly to a limit at about 3·5 eV above $v'' = 0$ of $^2\Pi_{1/2}$. A.

535.338.41–15

8616. An infra-red band-system of calcium oxide. M. HULTIN AND A. LAGERQVIST. Letter in *Nature, Lond.*, **166**, 190–1 (*July* 29, 1950).

535.342 : 539.133 : 537.228.4

8617. Classical theory of vibration and rotation absorption bands of homopolar molecules in a liquid subjected to an electric field. Resonance of the Kerr effect in the infra-red and ultra-hertzian ranges. A. KASTLER. *C.R. Acad. Sci., Paris*, **230**, 1596–8 (*May* 3, 1950) *In French.*

The theory of infrared absorption bands of homopolar molecules placed in an electric field is established and its analogy to Raman spectra is shown. Measurements carried out at radio-frequencies permit the deduction of molecular constants of anisotropic homopolar molecules. W. R. ANGUS

535.343–15 : 523.77

Fine structure of N_2O bands in the infrared solar spectrum. *See Abstr.* 8449

535.343.1–32

8618. Arc spectrum of gallium: new absorption lines in the Schumann region. W. R. S. GARTON. Letter in *Nature, Lond.*, **166**, 317–18 (*Aug.* 19, 1950).

535.343.2/.3–15

8619. The vibrational spectra and structure of inorganic molecules. II. Sulfur S_8, sulfur chloride S_2Cl_2, phosphorous P_4. H. J. BERNSTEIN AND J. POWLING. *J. Chem. Phys.*, **18**, 1018–23 (*Aug.*, 1950).

The infrared spectra from 2–25 μ have been obtained for S_8 as solid and in CS_2 solution; for S_2Cl_2 as liquid and in CS_2 solution; and for P_4 in CS_2 solution. A satisfactory assignment of the Raman and infrared spectrum of S_8 has been made on the basis of D_{4d} symmetry. The spectrum and valence force calculations are consistent with the C_2 structure for S_2Cl_2, and together with the electron diffraction data exclude the C_{2v} form. The vibrational spectrum of P_4 is interpreted unequivocally on the basis of the tetrahedral structure (T_d). A.

535.343.2

8620. The influence of the state of aggregation on the absorption spectrum of antimony triodide. K. V. BUTKOV AND I. A. VOITSEKHOVSKAYA. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 989–92 (1949) *In Russian.*

535.343.2 : 535.323

8621. Light dispersion in phenanthrene crystals. I. V. RODNIKOVA AND A. YU. EICHIS. *J. Exp. Theor. Phys., USSR*, **20**, 69–72 (*Jan.*, 1950) *In Russian.*

It was shown [Abstr. 3873 (1949)] that one may use successfully the Fresnel diffraction method for obtaining dispersion curves. In the present investigation, this method was used for the study of the dispersion of phenanthrene crystals. It is shown that the effective strength of the vibrator forces for the 3 490–3 500 Å absorption band is considerably smaller than for the first absorption band of anthracene.

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535.343.2 : 537.312.5 : 548.0

8622. Photoelectric and optical properties of silver halide crystals. P. V. MEĬKLYAR AND E. K. PUTSEĬKO. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 1) 63–5 (1950) *In Russian.*

Measurements of the spectral distribution of photoelectric sensitivity in crystals of AgCl and AgBr were made by two methods: (*a*) a condenser method without an electric field [Abstr. 3229, 7015 (1950)]; (*b*) determination of the photoconductivity. The sign of the charge carriers was determined by using the condenser method with the superposition of a const. electric field [Abstr. 8748 (1950)]. Subsidiary levels in the halides were detected by using a method described previously [Abstr. 4970 (1950)]. Detection and measurement of subsidiary absorption bands (before and after illumination) were made by a differential method on a photoelectric spectrophotometer. It was shown that for non-irradiated

AgCl and AgBr there is only one natural band of photoelectric sensitivity with max. of 365 mμ for AgBr and 315 mμ for AgCl. AgBr subjected to irradiation by light of 366 mμ gave two subsidiary photoelectric sensitivity bands with max. at 450–460 mμ and 540–600 mμ. For irradiated AgBr and AgCl in the region of natural sensitivity the conductivity had a "hole" character, while in the region of the subsidiary max. sensitivity the conductivity had an electronic character. By measuring the absorption of irradiated samples in relation to that of non-irradiated samples, subsidiary absorption bands were found with max. at 430–440 mμ for AgBr and 370–380 mμ for AgCl. Simultaneously with these absorption bands, longer wavelength bands were detected belonging to colloidal Ag with max. at 600–700 mμ for AgBr and 560–620 mμ for AgCl. New short wavelength absorption bands were observed by heating non-irradiated crystals, e.g. by heating AgBr from 20° to 200°C at 460–470 mμ, the absorption increased about 10 times, the max. being displaced towards the long wavelength side; on cooling the absorption retained its normal value. On the basis of the results obtained, the formation in irradiated crystals of centres analogous to *F*-centres in alkali halides is discussed. W. HUGHES

535.343.2 : 538.61 : 548.0

8623. Correction: The linear Zeeman effect in crystals. K.-H. HELLWEGE. *Z. Phys.*, **128** (*No.* 1) 172 (1950) *In German.*

In the paper under this title [Abstr. 7127 (1950)] the quantum number μ is erroneously referred to the threefold axis in the case of octahedral symmetry; it should be referred to the fourfold axis. This involves a correction in the enumeration of terms for ions with an odd number of electrons in a field of this symmetry. E. P. WOHLFARTH

535.343.2 : 548.0

8624. The equilibrium between *F*-centers and higher aggregates in KCl. A. B. SCOTT AND L. P. BUPP. *Phys. Rev.*, **79**, 341–6 (*July* 15, 1950).

The conversion of *F*-centres to centres giving a broad absorption band at about 700 mμ has been found to be primarily thermal rather than optical. Evidence is presented to show that these centres are higher aggregates of *F*-centres and lattice vacancies, but are not colloidal. At temperatures between 300 and 500°C the *F*-centres are in equilibrium with the higher aggregates; the equilibrium was studied as a function of temperature and concentration. Absorption measurements at — 195°C show that several species contribute to absorption in the band; some suggestions as to the likely nature of the centres are given. A.

535.343.2 : 548.7

Theory of the *F*-centres. *See Abstr.* 9112

535.343.3

8625. Spectral resemblances between azulenes and their corresponding six-carbon ring isomers. H. B. KLEVENS. *J. Chem. Phys.*, **18**, 1063–6 (*Aug.*, 1950).

The spectra of odd-ring compounds, azulene, 1,2-benzazulene, 2-phenyl azulene and indeno-azulene are compared with those of their corresponding regular isomers, naphthalene, phenanthrene, phenylnaphthalene and benzfluorene in part from 1 730 7 500 Å. The 5 band systems found in the azulen seem to correspond with respect to intensity, vibr tional structure and sequence to the 5 found in the corresponding isomers except that the former a shifted to lower frequencies. The lowest frequen band is shifted some 17 000 cm^{-1} to the red in th azulenes, which accounts for the colour observed these compounds, whereas the 4 transitions at high frequencies are shifted about 8 000 to 9 000 cm^{-1} compared with the corresponding regular isomer Decreases in total oscillator strengths with no linearity of these planar molecules as compared wi the linear compounds (a type of C_{2v} symmetry abo the long axis) are noted as has previously been show in the comparison of anthracene and phenanthren and tetracene and 1,2-benzanthracene and chrysene

535.343.31–

8626. Infrared study of some steroid compounds the 3 μ region. M.-L. JOSIEN. *C.R. Acad. Sc. Paris*, **231**, 131–3 (*July* 10, 1950) *In French.*

535.343

8627. The absorption spectrum and the dissociatio energy of fluorine. M. W. NATHANS. Letter i *J. Chem. Phys.*, **18**, 1122 (*Aug.*, 1950).

535.343.4–1

8628. The inversion spectrum of NH_3. M. TOMA SINI. *Nuovo Cim.*, **7** (*Suppl. No.* 1) 1–11 (1950) *Italian.*—Review.

535.343.4–1

8629. The microwave spectra and molecular structu of phosphorus and arsenic trichloride. P. KISLIUK AN C. H. TOWNES. *J. Chem. Phys.*, **18**, 1109–11 (*Aug* 1950).

The pure rotational spectra of PCl_3 and AsC have been observed in the microwave region, and th observed fine structure has been partially explaine The distance P–Cl is 2·043 ± 0·003 Å and th angle Cl–P–Cl is 100° 6′ ± 20′. The distance As–C is 2·161 ± 0·004 Å and the angle Cl–As–Cl 98° 25′ ± 30′.

535.343.4–1

8630. Microwave spectra of bromodiborane an vinyl bromide. C. D. CORNWELL. Letter in *J. Chem Phys.*, **18**, 1118–19 (*Aug.*, 1950).

535.343.4–14 : 539.13

8631. The radiofrequency spectrum of $Rb^{85}F$ an $Rb^{87}F$ by the electric resonance method. V. HUGH AND L. GRABNER. *Phys. Rev.*, **79**, 314–22 (*July* 1 1950).

The electrical quadrupole interaction constan eq_1Q_1/h, of Rb in RbF was determined for $Rb^{87}F$ rotational states $J = 1$ and $J = 2$ for the first fe vibrational states, and for $Rb^{85}F$ in rotational sta $J = 1$ for the first few vibrational states. The inte action constants are unusually large for an alka halide molecule; for the zeroth vibrational state $Rb^{85}F$, $eq_1Q_1/h = -70{\cdot}31 \pm 0{\cdot}10$ Mc/s and f the zeroth vibrational state of $Rb^{87}F$, eq_1Q_1/h $-34{\cdot}00 \pm 0{\cdot}06$ Mc/s. The absolute value of t interaction constant decreases about 1·1% from o vibrational state to the next higher one; the valu of the interaction constants for rotational stat

$J = 1$ and $J = 2$ are the same within the limit of error. The ratio of the electric quadrupole moment of Rb^{85} to that of Rb^{87} is $+ 2{\cdot}07 \pm 0{\cdot}01$. Results are reported on the spin-orbit coupling $c_2(\mathbf{I}_2 \cdot \mathbf{J})$, between the spin of the F nucleus and the molecular rotational angular momentum. For the zeroth vibrational state of $Rb^{85}F$, $|c_2/h| = 11 \pm 3$ kc/s and for the zeroth vibrational state of $Rb^{87}F$, $|c_2/h| = 14 \pm 4$ kc/s. No variation in $|c_2/h|$, with vibrational state was observed. Finally, an unpredicted line group was observed in the spectrum at one-half the frequency of one of the line groups in the $Rb^{85}F$ spectrum. Possible origins of this line group are discussed, including that of a double quantum transition. The vibrational frequency, ω_0, of $Rb^{85}F$ is 340 ± 68 cm^{-1}. A.

535.343.4–15

8632. The infra-red spectrum of borine carbonyl and a normal coordinate analysis of axial $WXYZ_3$ molecules. R. D. Cowan. *J. Chem. Phys.*, **18**, 1101–7 (*Aug.*, 1950).

The infrared spectrum of borine carbonyl has been investigated in the region 2 to 25 μ. Two perpendicular-type bands have been partially resolved, and indicate that the molecule is a symmetric top with symmetry C_{3v}. A normal co-ordinate analysis of axial $WXYZ_3$ molecules has been carried out and applied to H_3BCO, the following values having been obtained for the force constants: $k_{CO} = 17{\cdot}3$, $k_{BC} = 2{\cdot}97$, $k_{BH} = 3{\cdot}21$, $k_{BCO} = 0{\cdot}142$, $k_{HBC} = 0{\cdot}333$, $k_{HBH} = 0{\cdot}363$, all in units of 10^5 dynes/cm. A.

535.345

8633. Optical absorption in strontium oxide films. R. L. Sproull. Letter in *Phys. Rev.*, **78**, 630–1 (*June* 1, 1950).

535.345.1 : 535.376

8634. Scintillation conducting rods in tracer work. K. D. Timmerhaus, E. B. Giller, R. B. Duffield and H. G. Drickamer. *Nucleonics*, **6**, 37–41 (*June*, 1950).

An investigation of the light-conducting properties of lucite, plexiglas and polystyrene rods of various dimensions used in conjunction with IP28 photomultipliers and anthracene, naphthalene and NaI phosphors. L. R. Shepherd

535.345.6 : 535.247

8635. A note on the calibration and transmission of platinum filters. H. K. Paetzold. *Optik*, **6** (*No.* 6) 327–31 (1950) *In German.*

The spectral transmission curve of a Pt filter as used in photographic methods of photometry is measured by the method described earlier by the author [Abstr. 3460 (1947)]. A particular specimen, on ultraviolet transmitting glass, transmits 60% at 6 100 Å and 3 500 Å, 65% (max.) at 4 300 Å, and the transmissions decrease rapidly for wavelengths less than 3 500 Å. G. F. Lothian

535.347

8636. A photo-electric method for measuring circular dichroism. S. Mitchell. Letter in *Nature, Lond.*, **166**, 434–5 (*Sept.* 9, 1950).

In order to calculate rotatory dispersion curves, circular dichroism and rotation data are required. When the anisotropy factor of Kuhn is fairly large, a photoelectric method may be used to increase the accuracy of the circular dichroism data. The method and apparatus is briefly described; the latter is essentially a photoelectric colorimeter to which is added a polarizing prism and a $\lambda/4$ plate selected for the required region of the spectrum. The method can be used for moderately concentrated solutions and is rapid and simple. H. G. Jerrard

535.37

8637. Determination of the frequency and decay coefficient in the absorption band. V. K. Arkadiev and V. F. Vershinskaya. *J. Exp. Theor. Phys., USSR*, **20**, 48–53 (*Jan.*, 1950) *In Russian.*

Curves and interpolation formulae are given for the calculation of the characteristic frequency f_0 and decay coefficient θ (a measure of friction) in the interval $0{\cdot}001 < \theta < 1\,000$, or for a half-height bandwidth from 0·00436 to 11·4 decibels. The resonance band passes over to the viscosity band at $\theta > 10$.

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535.371

8638. Variation of the decay time of the fluorescence of anthracene and stilbene with temperature. J. O. Elliot, S. H. Liebson and C. F. Ravilious. Letter in *Phys. Rev.*, **79**, 393 (*July* 15, 1950).

535.371

8639. Duration of scintillations from organic phosphors. J. O. Elliot, S. H. Liebson, R. D. Myers and C. F. Ravilious. *Rev. Sci. Instrum.*, **21**, 631–3 (*July*, 1950).

Measurements have been made with gamma-ray irradiation. Interference between the output pulse from a photo-multiplier and its reflection from a shorted line is used to determine the time constants. A.

535.372

8640. Luminescence of anthracene and naphthalene. A. N. Faidish. *J. Exp. Theor. Phys., USSR*, **20**, 65–8 (*Jan.*, 1950) *In Russian.*

The results of luminescence investigations of naphthalene and anthracene vapours are presented, and the spectra are interpreted.

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535.375.5

8641. Low frequency Raman spectrum of a benzene single crystal. A. Fruhling. Letter in *J. Chem. Phys.*, **18**, 1119 (*Aug.*, 1950).

535.375.5

8642. Substituted methanes. III. Raman spectra, assignments, and force constants for some trichloromethanes. J. P. Zietlow, F. F. Cleveland and A. G. Meister. *J. Chem. Phys.*, **18**, 1076–80 (*Aug.*, 1950).

Raman displacements, semiquantitative relative intensities and precise depolarization factors for trichloromethane, fluorotrichloromethane and bromotrichloromethane were obtained in the liquid state. Several overtones and combination bands hitherto unreported are given and frequency assignments are made. The Raman data in the literature for CCl_3H, CCl_3D, CCl_3F, CCl_4 and CCl_3Br in the liquid state have been collected and the probable values ascertained. Force constants in modified valence force

potential functions containing all possible interaction constants were calculated for the 5 molecules. A.

535.375.5 : 536.7

8643. Substituted methanes. II. Vibrational spectra and calculated thermodynamic properties of deuterotribromomethane. S. M. FERIGLE, F. F. CLEVELAND, W. M. BOYER AND R. B. BERNSTEIN. *J. Chem. Phys.*, **18**, 1073–5 (*Aug.*, 1950).

Raman displacements, semiquantitative relative intensities, quantitative depolarization factors, and wave numbers and per-cent transmission for the infrared bands in the region 400–5 000 cm^{-1} have been obtained for CBr_3D. Details about the measurement of the depolarization factors are given. Thermodynamic properties—heat content, free energy, heat capacity and entropy—have been calculated from the spectroscopic and molecular structure data for 8 temperatures from 298·16° to 1 000°K. A.

535.375.5 : 536.7

8644. Substituted methanes. IV. Vibrational spectra and calculated thermodynamic properties of deuterotrichloromethane. J. R. MADIGAN, F. F. CLEVELAND, W. M. BOYER AND R. B. BERNSTEIN. *J. Chem. Phys.*, **18**, 1081–3 (*Aug.*, 1950).

Raman displacements, semiquantitative relative intensities, quantitative depolarization factors, and wave numbers and per-cent transmission for the infrared bands in the region 400–5 000 cm^{-1} have been obtained for CCl_3D. Thermodynamic properties—heat content, free energy, entropy and heat capacity—have been calculated from the spectroscopic and molecular structure data, to a rigid rotator, harmonic oscillator approximation, for nine temperatures from 298·16° to 1 000°K. A.

535.375.5 : 539.13

8645. Structure determination of molecules with the aid of the Raman effect. J. GOUBEAU. *Z. angew. Phys.*, **2**, 343–50 (*Aug.*, 1950) *In German.*

Review. 57 refs.

535.375.5 : 548.7

8646. Raman spectrum of crystalline barium chlorate. C. S. KUMARI. Letter in *Curr. Sci.*, **19**, 204–5 (*July*, 1950).

Nineteen lines were recorded under λ2536·5 Å excitation; these are classified in 3 groups: lattice spectrum (10), internal oscillations of ClO_3 ion (7), water bands (2).

535.376 : 539.166 : 537.542

Fluorescence of liquids under gamma bombardment. *See Abstr.* 8823

535.39

8647. Measurement of sixty-degree specular gloss. H. K. HAMMOND, III, AND I. NIMEROFF. *J. Res. Nat. Bur. Stand., Wash.*, **44**, 585–98 (*June*, 1950).

In order to determine the uncertainties involved in the calibration of gloss standards, the rate of change of gloss reading with change of aperture was investigated throughout the gloss scale. This was done by modifying an existing goniophotometer so that it became in effect a versatile glossmeter with provision for accurately controlling all of the known geometrical variables involved. Data obtained on the variation of gloss reading with aperture show that standards with widely different distributions of reflected light can be used to check the adjustment of glossmeters and t conformance of their apertures to A.S.T.M. specifi tions in the medium- to high-gloss range. T problem of obtaining the diffuse correction, wh involves source polarization and departure of t specimen from a perfect diffusor, has been investigat

535

8648. Propagation of electromagnetic waves throu a stratified medium. I. B. SALZBERG. *J. Opt. S Amer.*, **40**, 465–70 (*July*, 1950).

A general analysis, applicable to the entire class problems of plane multilayer systems, is develop The medium is assumed to be divided into m pla parallel layers, the first and mth of which are se infinite. The electromagnetic properties of the layers are unrestricted and dissimilar, and the thi ness of the $(m-2)$ finite layers are also different general. A steady-state monochromatic wa generated in the mth layer, is assumed to be incid at any angle upon the $(m-1)$th layer. Formulae the resulting reflection and transmission are deriv The methods which are employed in the paper fac tate application of these formulae, with a minimum algebraic complications, to specific problems.

535.39 : 535.4

8649. The reflectivity of thin silver films and the p formance of the Fabry–Perot interferometer. KUHN. *J. Phys. Radium*, **11**, 422–4 (*July*, 1950).

By measuring fringe widths in a Fabry–Perot eta the reflecting coefficient R of the silvered surfaces c be derived. The transmission factors T of the fil are measured directly with a photomultiplier tu The sum of $R + T$ is not markedly different different film thicknesses but increases from 0·84 λ3900 to 0·97 at λ6400. Direct measurements of are in agreement with those derived from frin widths. The data permit selection of the most su able film thickness to give reasonable intensity fringes. S. TOLANS

535.39 : 536.

8650. Energy transfer at the boundary of t absorbing media with an application to thermal rad tion in absorbing bodies. C. v. FRAGSTEIN. *A Phys., Lpz.*, **7** (*No.* 1–2) 63–72 (1950) *In German.*

The case of a plane wave from an absorbing medi falling on the boundary with a transparent medium examined theoretically. The energy balance at t interface can only be satisfied by supposing that standing wave is built up in the absorbing mediu Further, considerable variations in absorption efficients of both media have to be stipulated. T results lead to a correction of some work by von La E. H. DO

535.39 : 539

8651. The optical properties of thin platinum fil and their comparison with those of other metals. ROUARD. *J. Phys. Radium*, **11**, 390–4 (*July*, 1950) *French.*

The study of very thin films of Pt deposited on gl has shown up the existence of a very distinct minim of the reflection factor glass-metal for a thickness the metal of about 25 Å. This minimum appears the same thickness of the metal whatever the wa

length of the monochromatic light used. It is thus possible to suppress, without selectivity, all internal reflections in a glass or quartz plate. A.

535.391.2

8652. Reflection spectrum of fused quartz at 9μ. W. BRÜGEL. *Z. Phys.*, **128** (*No.* 2) 255–9 (1950) *In German.*

This was investigated with a prism spectrometer with NaCl prism. Secondary maxima were found in the region of 8·2 to 8·5μ and 8·8 to 9·3μ. The latter are in the same position as the maxima for crystalline quartz, but for the former only two secondary maxima are in agreement with the spectrum of crystalline quartz. C. TURNER

535.393

8653. A theorem relating to metallic reflection. F. ABELÈS. *C.R. Acad. Sci., Paris*, **230**, 1942–3 (*May* 31, 1950) *In French.*

The following theorem is stated and proved: If a plane wave is linearly polarized (1) in the plane of incidence, (2) normally to it, with r_1 and r_2 the respective coefficients of reflection at the interface of 2 homogeneous, isotropic and semi-infinite media having equal values of magnetic permeability, and if the first medium is transparent, the second being either transparent or opaque to the radiation, and if the angle of incidence in the first medium is 45°, then $r_2 = r_1^2$. The theorem is discussed in relation to experimental results. F. P. WOHLFARTH

535.41

8654. The generalized theory of thin films. F. ABELÈS. *J. Phys. Radium*, **11**, 307–9 (*July*, 1950) *In French.*

A theory of thin films is developed in which the concept of optical impedance is applied to the calculation of reflecting coefficients and phase conditions. Implications of the theory are discussed in relation both to discrete layers and to layers with slowly varying parameters. S. TOLANSKY

535.417

8655. The construction of interference filters for the transmission of specified wavelengths. K. M. GREENLAND AND C. BILLINGTON. *J. Phys. Radium*, **11**, 418–21 (*July*, 1950).

An experimental technique is described which permits the evaluation in vacuo of the thickness and reflectivities of the films used for the preparation of interferometric filters. By the method described the transmission of the filter can be fixed to within a wavelength of 20 Å. A total internal reflection method is employed. S. TOLANSKY

535.417

8656. Some further applications of multiple beam interferometry. I. Interferometric method for measuring differential polarization phase change at metallic reflection. S. TOLANSKY. *J. Phys. Radium*, **11**, 432–3 (*July*, 1950).

The differential phase change on reflection at a thin Ag film is measured from the doubling of white light fringes of equal chromatic order. Data are given for Ag using λ5461 Å with a film thickness of 350 Å over an angle of incidence 0–70°. The observations closely fit the values calculated from classical electromagnetic theory. The precision of measurement exceeds that reported earlier (Tolansky, *Phil. Mag.*, **35**, 149 (1944)] using Fizeau fringes. Even for a film thickness of 350 Å the multiple beams leads to very sharp fringes. S. TOLANSKY

535.417

8657. Some further applications of multiple beam interferometry. II. New multiple-beam localized fringes formed by strongly curved silvered thin plates. S. TOLANSKY. *J. Phys. Radium*, **11**, 434–5 (*July*, 1950).

If a thin sheet of mica is suitably silvered on both sides and then bent into cylindrical curvature of radius some centimetres, illumination with parallel monochromatic light leads to the formation of a system of extremely narrow rectilinear fringes localized strictly in a plane passing through the centre of curvature and normal to the direction of incidence. The properties of these fringes are discussed and a formula for the fringe pattern given. Fringe doubling due to birefringence of the mica and differential phase change is briefly reviewed. S. TOLANSKY

535.417

8658. Some further applications of multiple beam interferometry. III. A further application of localized white-light fringes of superposition. S. TOLANSKY. *J. Phys. Radium*, **11**, 436–7 (*July*, 1950).

The localized fringes of superposition formed by white light in a Fizeau arrangement are used for revealing inclusions and slight changes in refractive index on mica sheets. A sheet of mica silvered on both sides is cut in two and the sheets held parallel. The resulting fringe system is sufficiently sensitive to reveal easily optical path differences of even only 2·5 Å. "Invisible" inclusions are shown in mica of even very high quality. The technique is commended on account of its simplicity. S. TOLANSKY

535.417

8659. Some further applications of multiple beam interferometry. IV. The oscillation of quartz crystals as revealed by multiple-beam interferometry. S. TOLANSKY. *J. Phys. Radium*, **11**, 438–40 (*July*, 1950).

A brief description is given of an interferometric technique for examining the oscillations of piezoelectric crystals. The crystal has one surface highly polished and silvered. This is in close juxtaposition with a silvered optical flat and between these multiple beam Fizeau fringes are formed. When set into oscillation the change in fringe pattern produced by the moving surface reveals the distribution of vibration on the surface and the local amplitude of oscillation. Vibrations within the body of the crystal are studied by silvering a prepared crystal on two opposite sides. A stroboscopic technique is described in which fringes are produced with a source oscillating with the same frequency as the crystal. The oscillating Ag film does not appear to have its optical properties affected by the vibrations. S. TOLANSKY

535.417

8660. Some current developments in multilayer optical films. A. F. TURNER. *J. Phys. Radium*, **11**, 444–60 (*July*, 1950).

(1) A graphical vector method is described for deriving the refractive indices required in multilayer

reflection coatings for obtaining best achromatic conditions for compound anti-reflection layers. Double and triple combinations are discussed. (2) A "cold mirror" is described. This consists of a Ge film which reflects visible light but allows the infrared to pass through. As the reflectivity in the visible for Ge is only 45% it is increased to 90% by deposition of a 5-layer multifilm of MgF_2 and ZnS alternately, each $\lambda/4$ thick. (3) Selective reflectivity of metallic surfaces is produced by depositing multiple layers of alternate metal and dielectric on the metal surface. The reflectivity at the peak is not affected. The effect of having films of different thickness in the multiple combination is discussed. (4) Interference wavelength filters using multiple dielectric layers are described. The single dielectric type has a $\lambda/2$ film between metal surfaces. The multiple type has low-high refractive index pairs of films between the metal surface and the $\lambda/2$ spacer dielectric. Reflectance and transmission curves for Ag are given for before and after deposition of low-high combination films. Filters with 9 intermediate layers have been obtained with half-widths of transmission bands of only 11 Å. (5) A description is given of filters called frustrated total reflection filters. These consist of thin films of low index material between right-angled prisms of high index glass. Transmission and half-width characteristics are discussed. S. TOLANSKY

535.417

8661. Optical properties of thin solid films [survey of bibliography]. P. COTTON AND P. ROUARD. *J. Phys. Radium*, **11**, 461–79 (*July*, 1950) *In French.*

A comprehensive bibliographical survey covering some 250 publications. The literature is classified under 4 groups: (1) theoretical studies on optical properties of thin films; (2) technical methods for preparation of thin films including cathodic sputtering, thermal evaporation, chemical deposition and mechanical methods; (3) optical properties of both absorbing and transparent media in the form of thin films; (4) applications, including anti-reflection films, films for increasing reflectivity, interference filters, polarizers, protection of mirrors, the Fabry–Perot interferometer, etc. S. TOLANSKY

535.417

8662. The thickness measurement of thin films by multiple beam interferometry. G. D. SCOTT, T. A. MCLAUCHLAN AND R. S. SENNETT. *J. Appl. Phys.*, **21**, 843–6 (*Sept.*, 1950).

Only simple equipment is required, but reduction of the order of interference to as low as one makes possible the measurement of average thicknesses down to 10 Å. Applications have been made to evaporated films of six different metals and the method appears to be useful for all stable thin films in thicknesses up to several microns. Possible errors in the method and the precautions which may be taken to avoid them are discussed. A.

535.417 : 522.617.1

8663. The use of two Fabry–Perot interferometers in series for the detection of faint satellites. H. KUHN. *J. Phys. Radium*, **11**, 425–6 (*July*, 1950).

It is shown that the use of two identical Fabry–Perot interferometers in series leads to a great increase in the contrast, i.e. in the ratio of the transmitte maxima to minima. For the green Cd line a co trast factor of 3 000 has been experimentally obtain with two etalons of small spacing. The weak H isotope of abundance ratio 1 : 700 can be clearly see as a hyperfine structure when using a pair of 3·2 m spacer Fabry–Perot interferometers in series. De terium present in the amount 1 : 5 000 in H has al been detected. By paying attention to parasitic light a still better contrast ratio should be obtainabl S. TOLANSK

535.417 : 531.715.

8664. Interferometric evaluation of thicknesses thin films. S. TOLANSKY. *J. Phys. Radium*, **1** 373–4 (*July*, 1950).

A study is made of the validity of the multiple-bea interferometric method for measuring the thickness thin films. For a Ag film the deposit is made to cov part of an optical flat, and over this is evaporated much thicker metal film. The step height is measure interferometrically. It is shown that the heig measured is affected by the nature of the superpose metal. When Ag is superposed on an Ag film th final step value found is 25% less than that when C is deposited on an Ag film. The effect is considere to be due to bedding in of the superposed film on t the porous thin film. Studies are made with inte mediate films of cryolite and MgF_2. S. TOLANSK

535.4

8665. An experiment relating to the perturbatio caused in the propagation of a light wave by th presence of the edge of a metallic screen. A. MARÉCHA AND F. NAUDIN. *C.R. Acad. Sci., Paris*, **230**, 1515–1 (*April* 24, 1950) *In French.*

An interference experiment shows the perturbation of phase to be $\lambda/5$, and of amplitude to be confined t a band a few wavelengths wide. S. T. HENDERSO

535.42 : 534.2

8666. On the theory of diffraction. W. FRAN *Proc. Phys. Soc., Lond. A*, **63**, 925–39 (*Sept.*, 1950).

A new method is described for calculating th diffraction of an acoustical or electromagnetic wav by successive approximations. Kirchhoff's theo is a special case of the first step in the new metho which, unlike Kirchhoff's, is not restricted to blac screens, and applies to long waves as well as sho ones.

535.42 : 535.82

8667. Gabor diffraction microscopy: the hologra as a generalized zone-plate. G. L. ROGERS. Lett in *Nature, Lond.*, **166**, 237 (*Aug.* 5, 1950).

The hologram is considered as a generalized zon plate, transforming a point source into an ima resembling the original object used to generate th hologram. Both can act as a positive and negati lens, with a focal length $f \propto L^2/\lambda$ where L is the sca factor. Unlike the zone-plate, the hologram do not possess higher order foci, probably because the gradual tone variations in the hologram; th abrupt changes in the zone plate send appreciab light into the higher diffraction orders. {See al Abstr. 8786 (1950)}. R. W. FE

535.42 : 535.824

8668. Microscopy by reconstructed wavefronts. V. L. BRAGG. Letter in *Nature, Lond.*, **166**, 399–400 (*Sept.* 2, 1950).

Presents a simplified treatment of Gabor's method of reconstructing images of objects from photographs of the interference patterns produced when the object is illuminated by a coherent monochromatic wave-train. The photographic plate records only intensities, not phases, and the reconstruction therefore forms a second reversed image on the far side of the source. Analogies with X-ray analysis of crystals are given.

R. W. FISH

535.43

8669. Absorption measurements on scattering media. B. BUCHMANN-OLSEN. *Trans Danish Acad. Tech. Sci.* (*No.* 2) 24 *pp.* (1946).

Equations are developed for the transmission of a diffusing medium measured by a receiver (photocell or spectrograph), that collects only a portion of the transmitted light, considering a diffusing medium (*a*) obeying the cosine law, (*b*) scattering more light with small deviations (θ) according to the equation $I = I_0 \cos^4\theta$. Assuming Rayleigh's 4th-power law of scattering, it is shown that the transmission so measured is increased at longer wavelengths; thus the transmission maximum of a selective dyestuff will be shifted to longer wavelengths when it is combined with a diffusing medium, as in a dyed textile. This conclusion is confirmed experimentally for a coloured glass in contact with a ground-glass plate.

G. F. LOTHIAN

535.43

8670. The Christiansen experiment with spherical particles. C. V. RAMAN AND S. RAMASESHAN. *Proc. Indian Acad. Sci. A*, **30**, 211–15 (*Nov.*, 1949).

Glass in the form of tiny spheres is technically available, and by the use of a suitable appliance, the material can be sorted out so as to consist of particles of uniform size. It can then be very effectively used to exhibit the Christiansen effect. The spherical shape of the particles as well as their uniformity of size have some striking consequences which are not observed in the usual form of the experiment in which an irregular pack of powdered glass is employed. Four photographs illustrate the paper.

A.

535.434 : 541.18

8671. The use of white light in determining particle radius by the polarization ratio of the scattered light. M. KERKER. *J. Coll. Sci.*, **5**, 165–7 (*April*, 1950).

For dilute systems of small colloidal particles the difficulty of measuring the polarization ratio, ρ, is overcome by using white light instead of monochromatic light. Existing equations relating the radius of the scattering particle and ρ for monochromatic radiation are adapted to white light.

W. R. ANGUS

535.434 : 541.182.6

Particle size distribution in sulfur hydrosols by polarimetric analysis of scattered light. *See Abstr.* 9074

535.435

8672. On the intensity of Rayleigh scattering in diluted solutions. R. LOCHET. *C.R. Acad. Sci., Paris*, **230**, 2275–7 (*June* 26, 1950) *In French.*

For diluted solutions of many electrolytes (iodides and bromides of alkali and alkaline earth metals, also chlorides of large ions) the simplified equation $R - R_0 = HMc/\nu$ (R and R_0 Rayleigh constants for the solution, and water, respectively; H a constant for the given solute; M molecular weight of the solute; c concentration; ν number of ions from one molecule) holds good. Hence the solute ions in these solutions have disorderly distribution. For other electrolytes discrepancies can be found, especially in the case of highly hydrated ions. The deviation from the above relationship increases in the following order: NH_4^+, K^+, Na^+, H^+ for univalent, and Ba^{++}, Ca^{++}, Mg^{++} for bivalent cations. It has been found that aqueous solutions of sucrose scatter light much less than is required by theory. When ethanol is added, the disorder of sucrose molecules increases, and so does the intensity of scattered light.

F. LACHMAN

535.514.3

8673. Secondary images and their effect on the performance of double-image prisms and compensators. J. F. ARCHARD. *J. Sci. Instrum.*, **27**, 238–41 (*Sept.*, 1950).

The production of secondary images due to incorrect orientation of the two wedges or reflections from the end faces is discussed. In compensators the appearance of the fringes is changed by these same causes, and it is shown that this change can be deduced from a consideration of the inclined wave-fronts associated with the main and secondary images. The requirement that the two transmitted beams of a double-image prism should correctly represent both the amplitude and polarization of two incident components is also discussed.

A.

535.64

8674. Colorimetry. D. B. JUDD. *Circ. Nat. Bur. Stand.* (*No.* 478) 56 *pp.* (1950).

A general account of the bases of colorimetry, particularly the C.I.E. system, and of its applications. The treatment is fairly detailed and an extensive bibliography is given. Material standards of colour are described and 1-dimensional colour scales are included. (The term "colour temperature" is used in the American sense, i.e. not restricted to a near match of spectral energy distribution.) All the tables necessary for ordinary colorimetric computations are given.

J. W. T. WALSH

535.651

8675. The objective measurement of colour and colour changes. B. BUCHMANN-OLSEN. *Trans. Danish Acad. Tech. Sci.* (*No.* 4) 147 *pp.* (1950).

A review of previous methods of determining light fastness is given. Various tricolorimetric systems are described, compared, and their transformations described. Details of photo-electric colorimeter design and errors of measurement are discussed. The author's own apparatus is described and the underlying theory given; the equations are presented in matrix form (an appendix explains matrix calculation). The advantage of the instrument lies in its

characteristics approximating more nearly than any other to those of the C.I.E. standard observer. Uses of the instrument are mentioned and it is shown to be suitable for woven fabrics irrespective of their texture. A formula derived for the determination of colour differences is based on Fechner's law and the RUCS diagram. Checked by 12 observers, it gives good agreement with visual estimates. There are numerous useful graphs and tables, and an extensive bibliography.

R. A. WEALE

535.653

8676. White standards. K. MIESCHER AND R. ROMETSCH. *Experientia*, **6** (*No.* 8) 302–4 (1950).

Precipitation of barium sulphate with carefully purified reagents under carefully controlled conditions to avoid any contamination, and pressing of this barite in chromium-plated moulds with a trace of gelatine yields white standards of almost ideal properties: the high reflectance of 0·991 varies only ± 0·002 throughout the visible spectrum and practically no gloss can be observed. A.

535.653.3

8677. On the definition and measurement of whiteness. R. W. ASMUSSEN AND B. BUCHMANN-OLSEN. *Trans Danish Acad. Tech. Sci.* (*No.* 10) 23 *pp.* (1949).

Definitions and technical desiderata are given and previous methods reviewed. A new theoretical method, based on trichromatic measurements, is described, use being made of the logarithm of the luminance factor and the Breckenridge–Schaub co-ordinates. The method requires greater measuring accuracy than Selling's [*Meded. Vezelinst. T.N.O.* (*No.* 75) (1948)], but appears to tally better with visual sensations: hence its applicability to textile fabrics. It is not applicable to optical bleaching. Graphs are given. R. A. WEALE

535.653.3

8678. Whiteness relations and their applications. H. J. SELLING AND L. F. C. FRIELE. *Appl. Sci. Res.*, **B1** (*No.* 6) 453–76 (1950).

The whiteness grading according to several whiteness formulae was checked against the results of visual whiteness grading. For the simple empirical whiteness relations the formula of Stephansen gives the best correlations with visual data; the "brightness" measurement gives a somewhat smaller, but nevertheless fair correlation. For the grading of blued papers, however, only one formula of Judd (in which the colour difference white-black has to be taken 70 instead of 20 for the method of grading used) and two similar formulae of Selling show results which are in agreement with the visual grading. A method for determining the optimum dye concentration and the effectiveness of a blue dye when used for improving whiteness is indicated. A.

535.653.8

8679. Colour systems and atlases. C. L. BOLTZ. *Nature, Lond.*, **166**, 129–32 (*July* 22, 1950).

An explanation of the Munsell and Ostwald colour atlases and colour specification systems and their relationship to the more fundamental C.I.E. system. Based upon a discussion at the 50th meeting of the Colour Group of the Physical Society. The need for any colour specification system to be related to C.I.E. system is stressed. L. C. THOMS

535.6533

8680. Munsell reference colors now specified nine illuminants. D. NICKERSON AND D. H. WILSO *Illum. Engng, N.Y.*, **45**, 507–17 (*Aug.*, 1950).

Tables of the tristimulus values and chromatic co-ordinates for about 450 Munsell standards und C.I.E. illuminant *B*, fluorescent nominal 3 500 4 500°K, 6 500°K and "soft white." J. W. T. WAL

533

8681. A quantitative Schlieren apparatus witho photometry. J. EULER AND W. HÜPPNER. *Optik* (*No.* 6) 332–6 (1950) *In German.*

This system uses a dispersing prism to illumin the field and a slit in place of the usual knife ed The normal field will then be coloured, and a deviation will be shown as a change in this colo If a second dispersing prism with its axis at ri angles to the first is placed near the image pla deviations will be recorded as small spectra wh length is a measure of the deviation. Using a sou with a number of discrete spectrum lines, the Schlie field will show coloured contour lines whose deviat can be found from the known wavelengths. Sam photographs are given and practical details of apparatus discussed. R. W. F

533

8682. On a way of realising the shadow meth S. M. RAĬSKIĬ. *J. Exp. Theor. Phys., USSR*, 378–80 (*April*, 1950) *In Russian.*

A simple modification of the shadow method investigating optical systems is described in wh the diaphragm, covering the image of the sou takes a form allowing for the distortions due to errors of the optical system. The method also allo the distortions due to the auxiliary vessels placed the pencil of rays to be compensated. In the illumin ing system the usual slit is replaced by a grati consisting of a great number of slits, in the inter of increasing the optical power. Results of tests the new method are shown. B. F. KRA

533

8683. On phase-contrast testing with a slit sour E. H. LINFOOT. *Proc. Phys. Soc., Lond. B*, **63**, 527 (*July*, 1950).

In the standard form of the phase-contrast te the light-source is a pinhole comparable in size w the Airy disc of the system under test. As a con quence, it is difficult to obtain enough light throu the pinhole to carry out the test with full efficien If a slit source and a phase-changing strip are us this difficulty is overcome, but the properties of test are altered; for example, the brightness distrib tion seen on the surface of a true mirror under test is no longer radially symmetrical. In the pres paper the properties of the phase-strip test examined in the mathematically simplest case wh the light-source is a slit of negligible width, passi monochromatic light, and it is concluded that the t can safely be used in figuring an optical surface to accuracy of about one-twentieth of a fringe. Bel

this limit, the systematic error inherent in the usual interpretation of the test begins to be appreciable in the case of slow errors, though rapid local errors are correctly seen right up to the limit of sensitivity of the test. A.

535.8 : 771.351

8684. Photographic objectives with very large angles of field. H. NAUMANN. *Abh. Braunsch. Wiss. Gesell.*, **2**, 199–204 (1950) *In German.*

Lenses with extreme wide angles (180° or more) suffer from distortion and decrease of illumination in the margins of the field. The relationship between these two defects is derived. Details of a lens are given which covers the entire sky, yielding a star map on a stereographic projection. The aberrations of such a system are discussed. A proposed telescopic attachment converts a normal photographic lens into an extreme-wide-angle system. R. W. FISH

535.822

8685. Generalized microscopy and the two-wavelength microscope. M. J. BUERGER. *J. Appl. Phys.*, **21**, 909–17 (*Sept.*, 1950).

In the ordinary simple microscope, the same light is permitted to flow through the entire system. A more general microscope can be devised in which light of one wavelength is permitted to flow as far as the diffraction image of the object, then light of a second wavelength is substituted at this plane, and continues to flow through the rest of the optical system. It is shown that for such a generalized microscope, the magnification depends not only on the ordinary image-to-object distance ratio, but also on the ratio of wavelengths used. Utilizing X-rays and visible light, this second factor is about 10^4 diameters, and the whole magnification is of the order of 3×10^5. This is enough to permit one to see an atom. Apparatus has been built which realizes this theory. A most important characteristic of any such system is that a loss of phase occurs at the first diffraction image, where the wavelength substitution takes place. This phase must be supplied by the apparatus. It is accomplished with the aid of phase shifters prepared from a large uniform mica cleavage fragment. The apparatus and the results achieved with it are described. A.

535.824 : 535.42

Gabor diffraction microscopy. *See Abstr.* 8667–8

535.89

8686. Hollow-cathode source design for high resolution spectroscopic studies with small samples. O. H. ARROE AND J. E. MACK. *J. Opt. Soc. Amer.*, **40**, 386–8 (*June*, 1950).

A series of hollow-cathode tubes has evolved from the original Schüler type, for use at low temperature with valuable small samples (~ 10 mg). In the final tube assembly the light emerges with a divergence of *f*:3 through a 35 mm window. The cathode, of Al or Mg (or possibly Be) is clamp-sealed to the tube to be easily removable, yet in direct contact with liquid air. The tube has been used with a static rare gas supply as well as a conventional circulating system. Several quickly interchangeable sources have been used to make relative measurements of isotope shift with an uncertainty of about 2×10^{-8}. A.

HEAT 536

536.2.01 : 537.311.1 : 537.32

8687. The theory of the transport phenomena in metals. E. H. SONDHEIMER. *Proc. Roy. Soc.*, *A*, **203**, 75–98 (*Sept.* 7, 1950).

Exact expressions, valid for all temperatures, are obtained in the form of infinite determinants for the electrical conductivity, the thermal conductivity and the thermo-electric power of a degenerate gas of quasi-free electrons interacting with the ionic lattice of a metal. It is shown that the values of the electrical and thermal conductivities, in general, exceed the values given by the approximate interpolation formulae due to Bloch, Wilson and others, and, in particular, that the Grüneisen–Bloch formula for the ideal electrical resistance is appreciably in error in the region close to the Debye temperature. It is further shown that the residual and ideal resistances of an impure metal are not strictly additive in the region where the two are of the same order of magnitude. The behaviour of the thermal conductivity is shown to agree qualitatively with the discussion based on Wilson's formula given by Makinson; the numerical values of the thermal conductivity, however, are increased appreciably, particularly for an ideal metal at low temperatures. The thermo-electric power is also discussed, but no simple results can be given for the intermediate temperature range. A.

536.21

8688. Thermal conductivity of homogeneous materials. K. O. BEATTY, JR., A. A. ARMSTRONG, JR. AND E. M. SCHOENBORN. *Industr. Engng Chem.*, **42**, 1527–32 (*Aug.*, 1950).

A practical, rapid and simple unsteady-state procedure has been developed requiring only approximate values of diffusivity or heat capacity in addition to the data taken. A procedure for measurement of all thermal properties, diffusivity, heat capacity and conductivity from a single set of unsteady-state data with no additional thermal data is presented. The results obtained are not of high precision, but the limitations are experimental. The application of the method to substances which are non-homogeneous because the conductivity changes significantly with temperature should be possible by graphical and probably by analytical means. Substances having non-homogeneities because of composition differences in the direction of heat flow cannot be handled by the proposed method in its present form. A.

536.23

8689. Thermal conductivity of gas mixtures. A. L. LINDSAY AND L. A. BROMLEY. *Industr. Engng Chem.*, **42**, 1508–11 (*Aug.*, 1950).

An equation is developed for the thermal conductivity of gaseous mixtures which requires only a knowledge of the pure component conductivities, heat capacity or viscosity, boiling points and molecular weights. The equation reproduces 85 mixture

conductivities from the literature with an average deviation of 1·9%. A.

536.24

8690. Conduction of heat in composite slabs. J. C. JAEGER. *Quart. Appl. Math.*, **8,** 187–98 (*July*, 1950).

Results for steady flow through composite slabs can be easily calculated, but the case of transients is quite different. The latter are particularly important in many industrial problems, it being usually required to predict the transient behaviour of a given wall under given conditions or to compare the transient behaviours of two different walls. Results are obtained in terms of "the time-lag in establishing the steady state." Equations are solved by means of the Laplace transformation, the constants being functions of the thermal resistances and heat capacities of the various layers. Solutions are derived for several problems and complete numerical calculations are given for the system air-brick-cavity-brick-plaster-air. The definition of an "equivalent homogeneous wall" is briefly discussed. E. H. DOCK

536.24

8691. Solid-fluid heat exchange in moving beds. W. D. MUNRO AND N. R. AMUNDSON. *Industr. Engng Chem.*, **42,** 1481–7 (*Aug.*, 1950).

The problem of heat transfer and heat release in a fluid-moving solid exchanger has been considered for the case in which the solid is in the form of uniform spheres. It has been assumed that conduction in the fluid in the direction of flow is negligible and that the exchanger itself is adiabatic, so that no temperature gradient in a radical direction in the fluid exists. The former assumption is probably not objectionable but the latter will seriously limit the applicability of the formulae. Three cases considered here show that the approximate methods can be in error by a sufficient amount to invalidate their use for design purposes. The graphical method has no advantage over the precise solution since it not only gives results which are in error in the wrong direction but is probably more time consuming. Each of the methods has its own particular domain of application depending upon the parameters of the system. A.

536.24

8692. Heat transfer by spray cooling. E. LINACRE. Letter in *Research, Lond.*, **3,** 429 (*Sept.*, 1950).

536.24 : 532.517.4

A study on heat transfer in turbulent flow in a pipe. *See Abstr.* 8526

536.252

8693. The influence of electric fields on the convective heat transfer in liquids. G. AHSMANN AND R. KRONIG. *Appl. Sci. Res.*, **A2** (*No.* 3) 235–44 (1950).

It is shown experimentally that the convective heat transfer from a horizontal, electrically heated wire to a concentric cylinder, filled with different non-conducting liquids, is noticeably increased by the application of an electric field between the wire and the cylinder. The effect is studied in its dependence upon the nature of the liquid, the temperature difference used and the strength of the field. A discussion is given in terms of the similarity theory. A.

536.33 : 621.385.032

8694. Radiation transfer considerations in heating of a cathode sleeve. W. E. DANFORTH A T. A. HADDAD. *J. Franklin Inst.*, **250,** 135–45 (*Au* 1950).

The theory of radiation heat transfer is applied the problem of heating a cathode sleeve to h temperatures. Experiments have been made in wh metal and ceramic sleeves are heated by an inter cylindrical radiator. The results are discuss quantitatively in terms of the total emissivities of several surfaces.

536

8695. Radiation heating of a plane parallel slab a parallel semi-infinite heater. W. E. DANFOR *J. Franklin Inst.*, **250,** 146–50 (*Aug.*, 1950).

The problem is considered where a heater of em sivity e_1, is maintained at a temperature T_1. The s being heated has emissivity and equilibrium te perature e_2 and T_2 on its inner surface and e_3 and on its outer surface. The equation is develop which relates the three temperatures in terms of three emissivities.

536.41 : 538

8696. Ferromagnetic anomaly in the thermal pansion of ferrites. L. WEIL. *C.R. Acad. Sci., Pa* **231,** 122–4 (*July* 10, 1950) *In French.*

The thermal expansion of ferromagnetics chan in the Curie point region, and the observed values $(\delta l/l)$ at lower temperatures differ from the val obtained by extrapolation from above the Curie po by an amount here denoted by $(\delta l/l)_m$. This effe previously observed by Chevenard and others ferromagnetic metals and alloys, was investiga for ferromagnetic Zn, Co, Ni and Cu ferrites. F Fe_2O_3 . CuO the effect is complicated and depends previous heat treatment. E. P. WOHLFAR

536.413 : 536.42

8697. The thermal expansion coefficient and melting point of cubic elements. M. E. STRAUMA Letter in *J. Appl. Phys.*, **21,** 936 (*Sept.*, 1950).

If the linear expansion coefficient α of cu elements is plotted against the melting point the curve shows clearly that generally the lin expansion coefficient of cubic elements decreases w increasing melting point. There are no exceptio from this rule, only deviations from the curve. T curve seems not to be a simple one, although melting points of the 5 alkali elements fit well to empirical equation $\alpha\sqrt[3]{(T_F)} = \text{const.}$, T_F be expressed in °C.

536.423 : 542

8698. Countercurrent condensation with simultane exchange for two component mixtures. P. GRASSMA *Ann. Phys., Lpz.*, **7** (*No.* 1–2) 54–62 (1950) *In Germ*

Concentrations in the liquid and vapour phases a 2-component mixture condensing on a vertical inclined wall are investigated theoretically by c sidering simultaneous rectification of the rising vap and the falling liquid. The results are expressed terms of departures from an equilibrium curve.

E. H. DO

536.424 : 536.4.031 : 669.018

8699. On $\gamma \rightleftarrows \alpha$ transformation in Fe–Ni alloys by supercooling or superheating. S. TAKEUCHI. *Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, **1**, 43–50 (*May*, 1949).

The results of a study of the characteristics of the Fe–Ni alloy, its A_3^- transformation and the phase boundary between the γ and α modifications in the solid state, are described. It is concluded that, when heating or cooling with a marked hysteresis, the lattice alone can be transformed without change of concentration, and this occurs only in the time that the alloy is superheated or supercooled beyond the co-existing region of the two phases. C. A. HOGARTH

536.424 : 539.319

8700. On the behaviours of enormously large internal stress accompanying the transformation of a substance. K. HONDA. *Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, **1**, 1–6 (*May*, 1949).

Assuming that the $\gamma \rightarrow \alpha$ transformation starts from a single nucleus, the inner sphere being α-iron and the outer γ, the tension and pressure are calculated. If the internal stress is substituted for the pressure, then the change in the transformation point can be calculated by the Clausius–Clapeyron equation. Agreement with observed values is, in general, satisfactory; for instance, the A_3 transformation in pure Fe, Fe–Ni and Fe–Mn alloys. In the case of water, the model gives a value for the depression of the freezing point of $-29{\cdot}0$°C whereas, from Bridgman's results, and taking a linear variation with pressure, it should be -35°C. The advantages of the approach are outlined. A. J. KENNEDY

536.424 : 541.7 : 548.736.1

8701. On the transition of yellow phosphorus at low temperatures. T. SUGAWARA, Y. SAKAMOTO AND E. KANDA. *Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, **1**, 29–32 (*May*, 1949).

Results are given of an investigation on the change of structure accompanying the low-temperature transition of yellow P. The transition was found to occur at -72°. The low-temperature form showed birefringence, while the high-temperature form was isotropic. The transition was sharp and reversible. The unit cell of the high-temperature form was found to be of the body-centred cubic type and to contain about 236 atoms. The evaluation of the radial density distribution function $4\pi r^2\rho$ about any one atom confirms the existence of P_4 molecules in solid yellow P. No X-ray diffraction photographs of the low-temperature form could be obtained. F. LACHMAN

536.44 : 536.423.15

8702. The direct determination of the critical temperature and critical pressure of normal hydrogen. D. WHITE, A. S. FRIEDMAN AND H. L. JOHNSTON. *J. Amer. Chem. Soc.*, **72**, 3565–8 (*Aug.*, 1950).

A new apparatus has been constructed to measure accurately and directly critical constants of condensed gases. The critical constants of normal hydrogen have been determined and found to be $33{\cdot}24_4$°K and $2{\cdot}797$ atmospheres. The vapour pressure of normal hydrogen in the immediate vicinity of the critical temperature has also been measured. A.

536.453

8703. Ovens for accumulation of solar energy. F. TROMBE, M. FOËX AND C. H. LA BLANCHETAIS. *C.R. Acad. Sci., Paris*, **231**, 44–6 (*July* 3, 1950) *In French.*

In a site in the East Pyrenees, where the solar constant is about 1 kW/m², a temperature of 1 460°C is attained at the focus of a parabolic mirror of 600 cm² surface area. It is shown that temperature radiation from the material of the mirror itself is an important cause of loss of heat. A mirror of 53 cm² area (and therefore requiring a far smaller volume of material) gave a temp. of 2 600°C, while a mirror of 1 750 cm² gave a temp. of 1 070°C. The temp. obtainable is calculated as a function of area and heat loss, and agrees fairly well with experiment. N. CORCORAN

536.46 : 541.124

The reactions leading to the sodium *D*-line radiation in flames. *See Abstr.* 9064

536.46 : 541.126

8704. Determination of the thermal structure of a combustion wave by fine thermocouples. R. KLEIN, M. MENTSER, G. VON ELBE AND B. LEWIS. *J. Phys. Coll. Chem.*, **54**, 877–84 (*June*, 1950).

The method described involves the use of fine thermocouples (0·0005 in Pt–Pt . Rd) in conjunction with a string galvanometer. Temperature-time curves together with measurements of burning velocity allow determination of the temperature-distance curves. The analysis of a typical curve by means of an approximate equation for the heat balance in the combustion wave qualitatively demonstrates the distribution of the reaction rate throughout the wave. A.

536.46 : 541.126.2

8705. Determination of burning velocities from shadow and direct photographs of a flame. G. K. ASHFORTH, R. LONG AND F. H. GARNER. Letter in *J. Chem. Phys.*, **18**, 1112–13 (*Aug.*, 1950).

536.462

8706. Temperature measurements in luminous flames. H. BEHRENS AND F. RÖSSLER. *Z. Naturforsch.*, **5a**, 311–17 (*June*, 1950) *In German.*

A strongly and a weakly luminous acetylene flame and a special benzene flame were investigated in order to check the feasibility of putting the combustion gas temperature equal to that of soot particles in a flame. The colour temp. and the black-body temp. of soot particles were measured by a visual, a photographic and a photo-electric method. The true temp. was then calculated by a new method [Abstr. 7207 (1950)]. In the case of the strongly luminous C_2H_2 flame the optically measured temp. agrees well with that evaluated thermodynamically. For the C_6H_6 flame the temp. of the soot particles is considerably higher than the thermodynamically calculated temp. of the combustion gas. The temp. excess is explained by the release of the heat of recombination of radicals on soot particles. F. LACHMAN

536.48

8707. An order-disorder transition curve in cobalt ammonium sulphate below 0·1°K. C. G. B. GARRETT. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 1042–3 (*Sept.*, 1950).

536.48

8708. Some properties of He^3 and mixtures of He^4 and He^3. K. W. TACONIS. *Ned. T. Natuurkde.*, **16**, 101–8 (*May*, 1950) *In Dutch.*

Review of recently published work. H. LONDON

536.48

8709. A transfer device for low boiling liquids. A. WEXLER AND W. S. CORAK. *Rev. Sci. Instrum.*, **21**, 583–5 (*July*, 1950).

The principles involved in the transfer of low-boiling liquids under their own vapour pressures are indicated and calculations are presented for the specific case of the transfer of liquid N. A convenient device for transferring liquid N by this procedure is described and its operating characteristics are compared with the calculations. A.

536.48

8710. Liquid helium II: The hydrodynamics of the two-fluid model. P. R. ZILSEL. *Phys. Rev.*, **79**, 309–13 (*July* 15, 1950).

Exact non-linear equations of motion for reversible processes in the 2-fluid model of liquid He II are obtained from a variational principle of the type first introduced by Eckart in a different connection. Transitions between the 2 fluids are taken into account. Except for a term giving the effect of these transitions the equations obtained are substantially identical with those given by Landau. In the limit of very small velocities they reduce to the linear equations obtained by Tisza. The momentum and energy theorems are shown to be satisfied. A.

536.48

8711. Liquid helium films. I. The thickness of the film. K. R. ATKINS. *Proc. Roy. Soc.*, *A*, **203**, 119–32 (*Sept.* 7, 1950).

The thickness (d) of the He II film and its variation with height (H) and temperature were measured by a dynamic method involving the oscillations of a meniscus in a capillary. The variation with height could be represented only approximately by the equation $d = k/H^n$, as the effective value of n was greater at smaller values of H. The mean value of n over a range of heights from 0·5 to 5 cm was 0·14, which is appreciably smaller than the values predicted by the theories so far advanced to explain the formation of the film. The order of magnitude of k was 2×10^{-6} cm, but it varied slightly with the nature of the surface or some other experimental factor. A.

536.48

8712. Liquid helium films. II. The flow of the film. K. R. ATKINS. *Proc. Roy. Soc.*, *A*, **203**, 240–53 (*Sept.* 22, 1950).

The rate of flow of the He II film has been found to vary slightly with the height of the film and the pressure head. Most of the variation can be ascribed to changes in the thickness of the film, but a small residual variation at small pressure heads suggests that at least part of the flow is subject to frictional retardation. Measurements of the damping of the film oscillations enable a small upper limit to be put on the frictional retardation of the remaining part, but a similar method applied to flow through wide capillaries indicates that in this case most of the flow is opposed by frictional forces. The results are discussed in conjunction with the measurements Allen and Misener on flow through capillaries and an attempt made to formulate some of the gener features of the flow of the superfluid componen See also Abstr. 8711 (1950).

536.48 : 532.

Temperature-dependence of the viscosity of liquefi nitrogen and argon at constant density. *See Abs* 8522

536.48 : 536.

8713. Theoretical considerations on liquid helium J. DE BOER. *Ned. T. Natuurkde.*, **16**, 89–100 (*Ma* 1950) *In Dutch.*

Review on the state of order at absolute zero, order in co-ordinate and momentum space and on th theoretical aspects of the two fluid model.

H. LONDO

536.4

8714. Temperatures obtained by adiabatic d magnetization of a diluted chromium alum. D. KLERK, M. J. STEENLAND AND C. J. GORTER. *Physic* **16**, 571–6 (*June*, 1950).

Measurements have been carried out on a powder mixed crystal of Cr alum and Al alum containi 21·3 Al ions for each Cr ion. Even at the lowe temperatures reached no maximum of the suscep bility was found. Thermodynamic temperatur between 0·0014 and 0·019°K have been determin making use of the susceptibility as a thermomet parameter and heating by means of an oscillati magnetic field of 225 hertz.

536.483 : 533.

8715. A Joule–Thomson cascade liquefier for heliu J. ASHMEAD. *Proc. Phys. Soc., Lond. B*, **63**, 504 (*July*, 1950).

A He liquefier has been constructed with an outp of 3·8 l per hour and a starting time of 70 min. T liquid H needed to cool the He below its inversi temperature is provided continuously by a H liquef within the same machine. The advantages of t machine are: (i) short starting time, (ii) simplicity operation and ease of servicing, (iii) closed H circuit

536.5 : 535.373 : 778

Thermography. *See Abstr.* 9198

536.

8716. Correction of the temperatures measured optical and radiation pyrometers. J. WÜRSCHMI *Univ. Nac. Tucumán Publ.* (*No.* 464) 22 *pp.* (1949) *Spanish.*

A brief survey is made of the theoretical foundatio of the measurement of high temperatures by the kinds of pyrometers. Power of absorption a reflection, the laws of radiation, Wien's displaceme law, Planck's and Wien's formulae for the ener emitted by the black body, the relation betwe black body temperature and actual temperature, t production of black body radiation are dealt wi The application of these laws to the measurement the temperature of a hot body within and outside furnace by means of the optical instrument is d cussed and tables and graphs are given for the emiss power of various materials at an average wavelen of 650 mμ. Tables, graphs and a nomogram

given showing the temperature correction necessary in measuring with the optical pyrometer. While the optical pyrometer is working with monochromatic light the radiation pyrometer measures the radiation over the whole range of wavelengths. Here the Stephan–Boltzmann law is cited and similar tables for the total emission of various metals and for the necessary temperature correction for various temperatures and various values of the total emissive power are given. Hints are given regarding the choice between the 2 kinds of pyrometers. R. NEUMANN

THERMODYNAMICS 536.7/.8

536.7

8717. Thermodynamics. A modern introduction to general thermodynamics and its application to chemistry and physics. J. R. PARTINGTON. *London, Constable and Company* (1950) 263 *pp.*

A revised and enlarged edition (4th) of this well-known text. The contents include specific and latent heats, first law of thermodynamics, simple systems and physical changes, ideal solutions, non-ideal solutions and electrolytes, the Nernst heat theorem, statistical methods. Principal changes from previous editions are as follows: a modified treatment of the 2nd law; the adoption of symbols recommended by Chemical, Faraday and Physical Societies; a detailed treatment of activity and theory of Debye and Hückel; the addition of a chapter (49 pp.) on statistical mechanics; appendices dealing with general dynamics, extension of theory of electrolytes and properties of steam. The text is adequately illustrated and contains many worked examples. A collection of examples, with answers, is given for each chapter. F. E. HOARE

536.7

8718. The thermodynamics of irreversible phenomena. S. R. DE GROOT. *Bull. Acad. Roy. Belge Cl. Sci.*, **36** (*No.* 5) 413–18 (1950) *In French.*

The treatments due to Onsager and Verschaffelt are discussed; each divides the entropy change into an internal and an external part, and shows that any given change in a system may be resolved into the sum of a number of changes in a series of previously fixed directions, known as the "elementary phenomena." Verschaffelt advances a theory of superposition of energy changes, which agrees with Onsager's deductions from first principles. The author claims that Verschaffelt's treatment is valid only for the particular set of elementary phenomena chosen, and that Onsager's treatment is to be preferred as more general. N. CORCORAN

536.7 : 536.77

8719. The incomplete nature of the symmetry relations between thermodynamical quantities. R. C. L. BOSWORTH. *J. Proc. Roy. Soc., N.S.W.*, **82** (*No.* 3) 175–82 (1948).

A scheme for the representation of the symmetry relations between the thermodynamical variables and parameters having greater symmetry than those previously described is obtained by the introduction of new thermodynamic variables, $G-n\mu$, etc. (H, A, U instead of G), where n is the mole fraction and μ the chemical potential. The representation of a two-component system is discussed in detail. The change in the thermodynamic conditions which occurs on increasing without limit the size of the equipment in which a given reaction takes place is also considered. F. E. HOARE

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.12 : 530.145

8720. The quantum theory of the "radiating" electron. A. SOKOLOV. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 1013–16 (1949) *In Russian.*

537.132

8721. An attempt to detect thermal energy positrons. L. MADANSKY AND F. RASETTI. Letter in *Phys. Rev.*, **79**, 397 (*July* 15, 1950).

ELECTROSTATICS . DIELECTRICS 537.2

537.212 : 537.533.72 : 621.385.833

8722. Certain properties of electrostatic fields encountered in electron lenses. P. A. LINDSAY. *Proc. Phys. Soc., Lond. B*, **63**, 699–702 (*Sept.*, 1950).

The equipotential lines in a bipotential electron lens exhibit a fine structure which is revealed by application of the relaxation method to the solution of the Laplace equation in cylindrical co-ordinates. The asymmetry of the potential field between the two edges of the cylinders is confirmed by the same method and is established to be of the order of 2% in one particular case. A.

537.226 : 537.311.32

The mechanism of polarization in Rochelle salts. *See Abstr.* 8736

537.226 : 548.7

8723. Low frequency dispersion in ionic crystals containing foreign ions. R. G. BRECKENRIDGE. *J. Chem. Phys.*, **18**, 913–26 (*July*, 1950).

The anomalous electrical response at low frequencies previously observed in pure ionic crystals [Abstr. 1231 (1949)] has been studied in ionic crystals containing foreign ions. Measurements of the dielectric loss at 1 kc/s as a function of temperature have been made on 4 salts with a variety of foreign ions at several concentrations. A number of loss maxima was observed which depended in height on the concentration of the foreign ion and the heat treatment of the crystal, and in their position on the temperature scale on the nature of the salt and foreign ion. An interpretation of the results in terms of defect pairs of various types is presented. A.

537.226 : 621.315.612.4 : 621.3.011.5

8724. The structure, electrical properties and potential applications of the barium-titanate class of ceramic materials. W. JACKSON. *Proc. Instn Elect. Engrs, Pt III*, **97**, 285–9 (*Sept.*, 1950).

A review of the literature with 75 references.

537.226.1

8725. Theory of orientation polarization. A. A. BORGARDT AND B. N. FINKELSHTEIN. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 981–4 (1949) *In Russian.*

537.226.2

8726. The measurement of dielectric properties at varying temperatures. E. LINDHOLM. *Ark. Fys.*, **2**, *Paper* 21, 209–10 (1950).

The dielectric properties of materials such as wood which are heated by r.f. heating, are determined at various temperatures by noting the r.f. voltage and anode current of the r.f. generator and the temperature of the specimen of the material during heating, and then replacing the specimen by an air capacitor in parallel with a water resistor, the r.f. voltage and anode current being brought to the same values as before by adjusting the capacitor and resistor. The dielectric properties of the specimen are calculated from the capacitance of the air capacitor, the r.f. voltage and the power dissipated in the resistor.

E. RUSHTON

537.226.2

8727. Dielectric properties of formamide. G. D. BURDUN AND P. B. KANTOR. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 985–8 (1949) *In Russian.*

537.226.2 : 538.221 : 548.0

8728. Properties of single crystals of nickel ferrite. J. K. GALT, B. T. MATTHIAS AND J. P. REMEIKA. Letter in *Phys. Rev.*, **79**, 391–2 (*July* 15, 1950).

537.226.2/.3

8729. Microwave absorption and molecular structure in liquids. VI. Dielectric relaxation of four organic halides and camphor in different solvents. A. D. FRANKLIN, W. M. HESTON, JR., E. J. HENNELLY AND C. P. SMYTH. *J. Amer. Chem. Soc.*, **72**, 3447–54 (*Aug.*, 1950).

537.227

8730. On the sensitivity of pyro-electric crystals to modulated luminous radiations. C. ROSSETTI. *C.R. Acad. Sci., Paris*, **231**, 126–7 (*July* 10, 1950) *In French.*

The amplified potential developed in a crystal with white light falling on one (blackened) surface is inversely proportional to the modulation frequency if this is not too small. Experiments with monochromatic infrared radiation are described.

S. T. HENDERSON

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311

8731. Distribution in energy of Johnson noise pulses. B. R. GOSSICK. *J. Appl. Phys.*, **21**, 847–50 (*Sept.*, 1950).

The distribution is derived and checked against pulse-height measurements made with a linear amp fier and electronic counter. The following paramet are determined from the distribution functi (1) time of flight associated with a Lorentz mean f path, (2) the number of electrons which produc pulse of a given height, and (3) the potential an el tron falls through in a Lorentz mean free path.

537.311.1 : 537.32 : 536.2

The theory of the transport phenomena in met *See Abstr.* 8687

537.311

8732. General theory of deviations from Mathi sen's rule. M. KOHLER. *Z. Phys.* **126** (*No.* 6) 4 506 (1949) *In German.*

Mathiessen's rule that the measured resistance c metal results from the sum of two terms, a tempe ture-independent residual resistance term and temperature-dependent ideal resistance term, critically discussed, with particular reference to approximations made in its theoretical derivati The results of various experimental results are c sidered in the light of a general theory of deviati from the rule.

C. A. HOGAR

537.311

8733. On the inner potential of metals. M. BLA MAN AND V. F. G. TULL. Letter in *Proc. Phys. S Lond. A*, **63**, 913 (*Aug.*, 1950).

Experimental values for the inner potentials of and Au of 23 and 30 V respectively can be explai theoretically only if the kinetic energy of the c duction electrons is properly taken into account.

R. B. DIN

537.311

8734. The electrical resistance of liquid gallium the neighbourhood of its melting point. C. Do *Proc. Phys. Soc., Lond. B*, **63**, 662–4 (*Sept.*, 1950).

In order to determine whether any discontinu change in electrical properties takes place whe liquid is supercooled, measurements have been m on the resistance of liquid Ga. No such discontin has been found, the resistance varying linearly w temperature over the range investigated. The res yield values for the resistivity and temperature efficient of resistance of liquid Ga.

537.311

8735. Size effect variation of the electrical cond tivity of metals. D. K. C. MACDONALD AND SARGINSON. *Proc. Roy. Soc. A*, **203**, 223–40 (*S* 22, 1950).

Experimental results for the conductivity in t wires of pure Na of varying diameter in the absenc a magnetic field and also in the presence of longitud and transverse magnetic fields are given. Using general statistical theory of metals the variatio resistance with size in the case of conductivity wire square cross-section is calculated for comparison the first set of experiments. A theoretical invest tion follows of the alteration in conductivity produ in metallic films by the application of transverse m netic fields, and this is compared with the corresp ing experimental results obtained on the Na cylind

537.311.32 : 537.226

8736. The influence of a transverse electric field on electric conductivity and the mechanism of polarization in Rochelle salts. M. S. Kosman and A. N. Sozina. *J. Exp. Theor. Phys., USSR*, **20**, 39–47 (*Jan.*, 1950) *In Russian.*

An investigation is made of the variation with applied field of the resistance of electrodes which constitute the sides of a condenser. It is shown that if one uses graphite electrodes the resistance changes can be measured satisfactorily. The results of the investigation showed that the magnitude of the effect is directly associated with the amount of electricity accumulated on the condenser plates. This agrees with theoretical considerations. At the same time, on investigating the layers produced on the Rochelle salt to act as cathodes and anodes, it was found that the resistances were in many cases markedly different. This indicates that at least part of the charges associated with the electrode are produced not by classical mechanism of polarization but by a displacement of charges in the Rochelle salt.

BROOKHAVEN GUIDE TO RUSSIAN LITERATURE

537.311.33

8737. The reason for non-linearity of the volt-ampere characteristic of carborundum. V. I. Pruzhinina-Granovskaya. *J. Tech. Phys., USSR*, **19**, 100–10 (*Jan.*, 1950) *In Russian.*

It was determined that the electrical conductivity of the blocking layer of carborundum increases with the potential, due to the increase in mobility of electrons in the blocking layer, which is one of the reasons for the Pool effect. It was shown that the electron mobility of the blocking layer increases at the expense of the electron concentration.

BROOKHAVEN GUIDE TO RUSSIAN LITERATURE

537.311.33

8738. Influence of admixtures of sulphur on the electrical properties of selenium. N. V. Afanasev. *J. Tech. Phys., USSR*, **19**, 225–30 (*Feb.*, 1949) *In Russian.*

S introduced into Se up to 5% increases its electrical conductivity. In the temperature region 0–60°c, the electrical conductivity of both pure Se and an alloy of Se–S increases with increase in temperature according to the exponential law of Van t'Hoff. The dissociation energy for the electron decreases with increased addition of S. The dissociation energy and electrical conductivity of the Se–S alloy vary inversely as the increase of the S ion in the alloy.

BROOKHAVEN GUIDE TO RUSSIAN LITERATURE

537.311.33

8739. Theoretical Hall coefficient expressions for impurity semiconductors. V. A. Johnson and K. Lark-Horovitz. Letter in *Phys. Rev.*, **79**, 176–7 (*July* 1, 1950).

537.311.33

8740. Electronic mobility in germanium. V. A. Johnson and K. Lark-Horovitz. Letter in *Phys. Rev.*, **79**, 409–10 (*July* 15, 1950).

537.311.33 : 537.312.5 : 621.383.5

8741. Photoelectric effects in germanium. B. J. Rothlein and F. A. Stahl. *Sylv. Techn.*, **3**, 8–11 (*April*, 1950).

The qualitative theory of the Ge semi-conductor is discussed. Experimental curves showing the effect of illumination in shifting the characteristic of a point contact rectifier are given, and it is pointed out that a *p–n* barrier may be much more sensitive than a metal-semi-conductor contact since the barrier height is greater and the active area larger. The use of two probe contacts on a Ge block as a photo-switch is illustrated. A. H. W. BECK

537.311.33 : 537.531

8742. X-ray-produced electron currents in KCl crystals. H.-U. Harten. *Nachr. Wiss. Göttingen*, IIa (*No.* 3) 15–21 (1950) *In German.*

Electron currents are produced in the matrix of KCl single crystals by irradiation with X-rays. Impurities greatly influence the magnitude of these currents by acting as electron traps. Above −170°c the captured electrons are released again (thermal process). The incident energy was 5 W sec/m² which produced a max. of 3×10^{14}/cm³ colour centres. The effects produced by the absorption of X-ray energy are similar to those produced by luminous energy (light). W. SUMMER

537.311.33 : 538.632

8743. Some properties of high resistivity P-type germanium. W. C. Dunlap. *Phys. Rev.*, **79**, 286–92 (*July* 15, 1950).

The Hall effect, resistivity, and rectification characteristics of this material were studied with respect to changes of temperature and magnetic field. A very high mobility figure at 25°c (~2 730 cm²/V-sec for a field of 3 600 gauss) was obtained by calculating $10^8R/\rho$. An effect of type of contact at the Hall probes on Hall effect measurements is pointed out. The resistivity of the material was 18·8 ohm-cm average, the Hall coefficient $5{\cdot}14\times10^{-4}$ V-cm/amp.-gauss. The magneto-resistance of this Ge amounted to about 22% in a field of 13 750 gauss. The Hall coefficient decreased by about 22% between 3 600 and 13 750 gauss. The band separation for one sample was 0·82 V from Hall effect data, 0·75 from the resistivity. The mobility was found to obey a $T^{-2\cdot9}$ law in the temperature range 78 to 400°K. This *P*-type material exhibited only slight rectification. A.

537.311.33 : 538.222

8744. Investigations on the hydrated molybdenum blue. L. Sacconi and R. Cini. Letter in *J. Chem. Phys.*, **18**, 1124 (*Aug.*, 1950).

537.311.33 : 621.315.59 : 621.317.3

8745. Measurement of the electrical and magnetic constants of semi-conductors at u.h.f. by the concentric line method. G. Untermann. *Z. angew. Phys.*, **2** (*No.* 6) 233–41 (1950) *In German.*

By means of graphical solutions of certain functions, the permittivity, conductivity, permeability and magnetic losses at u.h.f. may be readily calculated from conductance measurements. C. A. HOGARTH

537.311.6

8746. Alternating current conduction in ice. E. J. Murphy. Letter in *Phys. Rev.*, **79**, 396–7 (*July* 15, 1950).

From measurements of a.c. conduction in ice and assuming Pauling's theory the energy of the H bond in ice is determined as 5·75 kcal/mol in good agree-

ment with $5{\cdot}8 \pm 0{\cdot}2$ kcal/mole obtained from the heat of sublimation. G. F. J. GARLICK

537.312.5

8747. Theory of photo-electric conductivity in mixed conductors. F. STÖCKMANN. *Z. Phys.*, **128** (*No.* 2) 185–211 (1950) *In German.*

An attempt is made to present the general principles of a quantitative treatment of photo-electric currents. It is shown that photo-electric currents in crystals can be derived immediately from the fundamental conceptions. All formulae are based on the principle that free electrons are produced in an illuminated crystal. The amplification factor $1/(1-\gamma_D)$ of the primary current is also explained by the principal equations. This amplification exists if the dark conductivity has an electronic part γ_D. The field current is shown to be the cause of the amplification of photo-electric currents in semi- and mixed conductors. In general, the relationship is discussed between the fundamental equations of electric conductivity and photo-electric currents. W. SUMMER

537.312.5

8748. Application of the condenser method to determine the sign of the carrier of photocurrent. E. K. PUTSEIKO. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 1009–12 (1949) *In Russian.*

537.312.5

8749. Rise times of voltage pulses from photomultipliers. O. MARTINSON, P. ISAACS, H. BROWN AND I. W. RUDERMAN. Letter in *Phys. Rev.*, **79**, 178 (*July* 1, 1950).

537.312.5

8750. Photoconductive cells of cadmium selenide. E. SCHWARZ. Letter in *Proc. Phys. Soc., Lond. B*, **63**, 624–5 (*Aug.*, 1950).

537.312.5 : 548.0 : 535.343.2

Photoelectric properties of silver halide crystals. *See Abstr.* 8622

537.312.62

8751. Zero-point vibrations and superconductivity. J. BARDEEN. Letter in *Phys. Rev.*, **79**, 167–8 (*July* 1, 1950).

A theory of superconductivity based on the idea that the vibrational modes of the superconducting state differ from those of the normal state in that the vibrations are such as to lower the energy of electrons in states near the surface of the Fermi distribution. The theory explains the isotope effect. R. B. DINGLE

537.312.62

8752. On the isotope effect in superconductors. J. DE LAUNAY. Letter in *Phys. Rev.*, **79**, 398–9 (*July* 15, 1950).

537.312.62

8753. Superconducting bismuth alloys. J. M. REYNOLDS AND C. T. LANE. Letter in *Phys. Rev.*, **79**, 405–6 (*July* 15, 1950).

The intermetallic compounds NaBi and KBi_2 have transition temperatures of $2{\cdot}2_4°$ and $3{\cdot}6_0°$K, transition ranges at zero field of $0{\cdot}05°$ and $0{\cdot}07°$ and initial slopes dH_{crit}/dT of 180 and 130 gauss/°K respectively. There is an almost complete lack of hysteresis and the general behaviour is that of a pure metal and not of an alloy. For the measurement Webber's a.c. induction method [Abstr. 6210 (1949)] was used. The superconductivity of KBi_2 had so far not been reported; for NaBi see Abstr. 978 (1950).

H. LONDON

537.312.6

8754. Field variation of the superconducting penetration depth. A. B. PIPPARD. *Proc. Roy. Soc.*, *A*, **203**, 210–23 (*Sept.* 22, 1950).

The high-frequency technique developed previously [Abstr. 8755–6 (1950)] has been used to investigate the dependence of the penetration depth in superconducting tin on the strength of the applied field. A steady magnetic field was applied transverse to a thin cylindrical specimen forming part of a 3 cm resonator, any resulting change in penetration depth being revealed as a shift in the resonant frequency. The change was greatest close to the transition temperature ($3{\cdot}72$°K), but even here it amounted to no more than 3% at the critical field strength. As the temperature was lowered the effect became smaller at first, reaching a very low value at 3°K, and then increased once more to about 2% at $1{\cdot}7$°K. The effect of a steady magnetic field on the high-frequency resistance was also studied, though not in great detail. Above 3°K the resistance decreases slightly until at a field strength rather greater than $\frac{1}{2}H_c$ a sudden increase announces the formation of the intermediate state. At lower temperatures the effect of the steady field is to increase the resistance slightly. It is suggested that the very small change in penetration depth even at the critical field strength is evidence of the existence of long-range order in the superconducting state over a distance of 10^{-4} cm or more, and the very sharp resistance transition in pure superconductors is adduced as further evidence of this hypothesis.

537.312.62 : 537.311

8755. The surface impedance of superconductors and normal metals at high frequencies. IV. Impedance at 9 400 Mc/sec of single crystals of normal and superconducting tin. A. B. PIPPARD. *Proc. Roy. Soc.*, *A*, **203** (*No.* 1072) 98–118 (1950).

The measurements described in the earlier paper [Abstr. 3541–3 (1947)] have been extended to 9 400 Mc/s, a resonance technique being employed to determine the surface resistance of normal and superconducting tin, and the difference between the surface reactances of the material in the two states. Measurements on single crystals of different orientations have brought to light a marked anisotropy of all these quantities, of a kind which shows clearly the non-tensorial nature of the fundamental equations relating the field vectors. The prediction of the theory of the anomalous skin effect in normal metals, that the surface resistance should vary with frequency as $\omega^{\frac{2}{3}}$, is confirmed. The temperature variation of the resistance and reactance of superconducting tin has been studied in detail for a number of specimens of different orientations, and it has been found that over certain ranges of temperature the shapes of corresponding curves for different specimens are similar, apart from scaling factors depending on the orientation; the values of these scaling factors are used to characterize the surface impedance of each orientation.

537.312.62 : 537.311.6

8756. The surface impedance of superconductors and normal metals at high frequencies. V. Analysis of experimental results for superconducting tin. A. B. PIPPARD. *Proc. Roy. Soc., A*, **203**, 195–210 (*Sept.* 22, 1950).

For the purpose of analysing the experimental results presented in the earlier parts of this series the concept of a 2-parameter 2-fluid model of superconductivity is developed, and it is shown that current theories are special cases of this model. The part played by the resistive mechanism in modifying the surface reactance is discussed, and it is concluded that the temperature variation of inductive skin depth at the lowest temperatures represents the variation of the superconducting penetration depth. The dependence of this quantity on crystal orientation is different from what would be expected from the theory of London & London, and it is concluded that there may be grounds for doubting the validity of this theory, or at least its application to high-frequency phenomena. The dimensional analysis of the resistance measurements shows them to fit reasonably well into the framework of the 2-fluid model, but the implications of the particular form of the model which is deduced from the results are in disagreement with other general considerations. In particular, the resistance is found to vary too slowly with frequency and with the fraction of normal electrons. A.

537.312.62 : 538.639

8757. Meissner effect in superconducting alloys of indium and thallium. J. W. STOUT AND L. GUTTMAN. Letter in *Phys. Rev.*, **79**, 396 (*July* 15, 1950).

537.323

8758. Evaluation of thermo-electric powers from metals of ideal purity. M. KOHLER. *Z. Phys.*, **126** (*No.* 6) 481–94 (1949) *In German.*

It has previously been shown that for metals of varying purity, following the laws of Mathiessen and of Grüneisen and Goens, $\varepsilon = (1-p)\varepsilon_0 + p\varepsilon_i$ where ε is the thermo-electric power as measured, ε_i is the thermo-electric power for the pure metal, ε_0 is a thermo-electric contribution arising from lattice defects and impurities, and p is a constant depending on the residual resistance of the metal and the temperature. From experiments on metals of varying impurity content, ε_0, ε_i and p may be determined from measured values of ε at different temperatures. The calculated values of ε_i and even their signs are not in good consistent agreement, and a derived qualitative relation is found to fit the experimental results better. For several metals (Au, Ag, Cu) $\varepsilon/\varepsilon(\Theta)$ is found to yield a universal value as a function of reduced temperature T/Θ, for values of T/Θ greater than 0·5, Θ being the characteristic temperature. Below 0·5 there are significant differences between different metals. C. A. HOGARTH

537.324

8759. Note on thermoelectric generation of current. M. B. GREEFF. Letter in *J. Appl. Phys.*, **21**, 943 (*Sept.*, 1950).

Telkes has given a formula for the efficiency of any thermocouple for which the Wiedemann–Franz–Lorenz law applies [*J. Appl. Phys.*, **18**, 1116 (1947); Paper, *J. Appl. Phys.*, **19**, 1180 (*Dec.*, 1948); Abstr. 1099 B (1949)]. Calculations show that the efficiency of a thermocouple may be much higher than has been hitherto anticipated provided the couple delivers power above 200 μV per °C. At 500 μV per °C an efficiency of 20·9% can be anticipated if the temperature difference between the junctions is 500°C. A complete characteristic of a thermo-electric generator is calculated on 4 different bases of construction, viz. using thermocouple elements of (1) 100 μV per °C, (2) 500 μV per °C, and (3) changing the internal and external resistances in case (2), and (4) reducing the number of elements in (3). Case 3 having $\frac{1}{5}$ the elements of case (1) has 5 times the efficiency. Case (4) having $\frac{1}{9}$ the elements of case (1) has 9 times the efficiency of case (1). The energy output in all cases is the same. Using only $\frac{1}{25}$ of the elements in case (1) it would be possible to deliver 35 A at 36 V. The efficiency is 29%. J. S. G. THOMAS

537.36 : 537.565

8760. Migration of lithium and several multicharged ions through quartz plates in an electric field. II. G. GIBSON AND R. C. VOGEL. *J. Chem. Phys.*, **18**, 1094–7 (*Aug.*, 1950).

See Abstr. 5851 (1950). The kinetics of the migration of Li ions through crystalline quartz plates has been studied. The migration is induced by an electric field and probably takes place through tunnels inherent in the crystal structure and parallel to the principal axis of the quartz. It was shown that the rate-determining step is not the migration within the quartz plate, but is some step associated with the passage of the Li ions into or out of the quartz plate. A previous investigation showed that the migration within the quartz plate is the rate-determining step for Na ions. It was demonstrated that neither Mg, Zn, Cd nor Bi ions will migrate through quartz plates under our experimental conditions. Cu ions migrated through the quartz plates but caused the plate to crack in each experiment. A.

537.363

8761. Influence of the electric charge on the obstacle in the mechanism of capture of particles suspended in a fluid in motion. M. PAUTHENIER AND R. COCHET. *C.R. Acad. Sci., Paris*, **231**, 213–15 (*July* 17, 1950) *In French.*

The general equation for the movement of a neutral spherical particle suspended in a fluid in motion and located near an obstacle electrically neutral is given. The modification to the equation when the obstacle is electrically charged is derived and applied to the problem of the motion of droplets constituting fog particles towards high voltage transmission lines. R. DAVIS

537.363 : 541.133.1

8762. Measurement of ion migration on paper in an electric field. Transference numbers of nickel and copper sulfates. H. J. MCDONALD, M. C. URBIN AND M. B. WILLIAMSON. *Science*, **112**, 227–9 (*Aug.* 25, 1950).

ELECTRIC DISCHARGES 537.52

537.521.7

8763. The electric spark in uniform fields. G. M. PETROPOULOS. *Tekh. Khron.*, **27**, 312–40, 388 (*June*, 1950) *In Greek.*

The spark formation in uniform fields is considered, under atmospheric pressure. The Townsend mechanism of breakdown is valid up to $pd \sim 500$ mm/cm. Above this limit the streamer mechanism prepares the discharge. Meek and Raether criteria are considered and calculation results for the minimum breakdown voltages are compared in the table with experimental data. However, the lengths swept by the avalanches, as computed from Meek and Raether equations under actual minimum sparking voltages, are less than the respective gap lengths for $d > 1{\cdot}6$ cm. These results show that the avalanches reach their critical lengths in this case before crossing the gap and that they probably transform themselves into anode directed streamers, as happens under overvoltages. Recent results obtained by the author [Abstr. 5856 (1950)] give further arguments for the avalanche transformation under minimum breakdown voltage, and determine the validity limit of Townsend criterion at about $pd = 500$ mm/cm. A.

537.523.3

8764. Two-pole Lichtenberg figures. G. KNOERZER AND W. KOSSEL. *Naturwissenschaften*, **37**, 357 (*Aug.*, 1950) *In German.*

537.523.4

8765. Voltage gradients in long gaseous spark channels. J. B. HIGHAM AND J. M. MEEK. *Proc. Phys. Soc., Lond. B*, **63**, 633–48 (*Sept.*, 1950).

Oscillographic measurements have been made of the variation with time of the voltage drops in long spark channels conducting aperiodic impulse currents rising to a peak in about $\frac{1}{4}$ μsec and decaying to half-value in from 10 to 85 μsec, with peak currents ranging from 60 to 700 A. The lengths of the spark channels have been measured photographically, and the mean voltage gradients along the channels have been estimated. Results are given for sparks in air, N_2, O_2 and H_2 at atmospheric and reduced pressures. Some preliminary measurements are described for sparks in water and oil, and for sparks in glass tubes. The voltage gradients in the various gases, with the exception of H_2, are independent of the peak current, but are influenced by the rate of current decay. The results are correlated with the current densities in spark channels, as recorded in a separate investigation. A.

537.523.4

8766. The expansion of gaseous spark channels. J. B. HIGHAM AND J. M. MEEK. *Proc. Phys. Soc., Lond. B*, **63**, 649–61 (*Sept.*, 1950).

A rotating mirror camera with a temporal resolution on the film of 1·5 mm/μsec has been used to determine the rate of expansion of long gaseous spark channels during their first 10 μsec of growth. The spark channels conducted aperiodic impulse currents in the range of 60 to 500 A peak, which attained their peak values in about $\frac{1}{4}$ μsec and decayed to half-value in 10 or 28 μsec. Sparks have been investigated in air at atmospheric and reduced pressures, and N_2, O_2 and H_2 at atmospheric pressure. The measure areas of cross-section of these spark channels bear linear relation to the peak currents, except in H_2, ar are little influenced by the rate of current decay in th range studied. Measurements have also been mad with the rotating mirror scanning an image of th spark across a photomultiplier connected to a high speed oscillograph; by this method a direct record obtained of the radial light distribution across th spark channels. The mechanism of spark chann expansion is discussed, and estimates are made of th average ion densities in spark channels.

537.52

8767. Observations on some properties of ultra-hig frequency gas discharges. C. F. ROBINSON. *Rev. Sc Instrum.*, **21**, 617–22 (*July*, 1950).

A series of experiments designed to yield informa tion on the mechanisms of u.h.f. discharges whic influence the operation of ion sources employing suc discharges is described. The main conclusions ar that such discharges exhibit a high negative spac charge due principally to secondary emission fro the walls of the discharge chamber and that io production is inhibited by the space-charge trap s formed, that under certain conditions extremely intens electron beams may be obtained from a resonan cavity containing a gas discharge, and that fairl large ion currents may be obtained by the interactio of the emergent gas and the emergent electron bea in the exit orifice of the cavity. A

537.527.

8768. Measurements of radial temperature variation in wall-stabilized high pressure mercury arcs. O. KOCH *Z. Phys.*, **126** (*No.* 6) 507–21 (1949) *In German.*

Describes measurements made by passing a bea of ~ 30 kV X-rays through the arc and so deter mining, from the beam absorption, the gas densit and thus the temperature in the discharge. Th temperatures measured ranged up to nearly 6 000°K with vapour pressures varying between 600 an 1 200 mm Hg. The results are compared with th theoretically derived equation for radial temperatur variations. J. D. CRAGG

537.528 : 621.315.61 : 621.3.015.5

8769. Electrical puncture of liquid dielectrics wit suspended metals. L. G. GINDIN, L. M. MOROZ I. N. PUTILOVA, YA. I. FRENKEL AND O. A. SHPAN SKAYA. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 4) 671– (1950) *In Russian.*

Experiments on benzene and vaseline with 0·00 to 1% of Al in suspension show that movement o metal particles towards the cathode starts at 300 V and accelerates with increase in voltage. These ma form an aggregate filling the entire space between th electrodes without a puncture until a critical voltag E is reached, which for Al in benzene is 4 kV/cm having the "induction period"—the time lag betwee the application of E and puncture—of several seconds At puncture the aggregate falls down, leaving only thin link between the electrodes. This link is main tained indefinitely when carrying even a small current otherwise will break down after a definite period o time depending upon the ratio of specific weights o

metal and of the dielectric. Value of E depends upon the dielectric constant, also size of metal particles, and is independent of their shape, also of the material, size, shape, surface and position of the electrodes.
J. LUKASZEWICZ

537.529 : 537.226 : 548.0

8770. Notes on the theory of dielectric breakdown in ionic crystals. H. FRÖHLICH AND F. SEITZ. *Phys. Rev.*, **79**, 526–7 (*Aug.* 1, 1950).

X-RAYS 537.531

537.531 : 535.42

8771. X-ray diffraction by solid soaps. A. J. STOSICK. *J. Chem. Phys.*, **18**, 1035–40 (*Aug.*, 1950).

Arguments are presented to show that X-ray diagrams obtained by using the powder technique for common soap samples can be interpreted in terms of two kinds of disordering. The first kind of disorder, a stacking disorder of micellar layers, makes the layers optically independent for certain diffraction maxima so that continuous diffraction bands arise rather than discrete maxima. A second kind of disorder within a layer in which long chain ions are randomly oriented with respect to rotation about their long axes causes all but one set of bands to be weak. A consideration of these two disorders permits extensive unification of the results of X-ray diffraction experiments for poorly crystallized soaps. The use of such diffraction patterns for phase studies is subject to severe uncertainties. A.

537.531 : 535.42 : 548.73

8772. X-ray diffraction by elastically deformed crystals. J. E. WHITE. *J. Appl. Phys.*, **21**, 855–9 (*Sept.*, 1950).

Published articles establish the fact that vibration or other inhomogeneous strain greatly increases the ability of a crystal to diffract X-rays. The present article gives experimentally determined relations between integrated intensity and strain for the rather simple case of static bending. All measurements were made on quartz plates, but a wide range of geometrical and crystalline parameters was covered nevertheless. In some cases, the integrated intensity for extreme bending was more than 20 times that from the unbent crystal. An approximate theory is developed for computing the effects of other types of strain or of other combinations of crystalline parameters. A qualitative study of vibrating crystalline plates is also described briefly. A.

537.531 : 535.822.9

8773. An approach to X-ray microscopy. P. KIRKPATRICK. *Nature, Lond.*, **166**, 251–3 (*Aug.* 12, 1950).

Images free from astigmatism can be formed with X-ray beams after two glancing incidence reflections at curved surfaces. An X-ray microscope having glass mirrors, metal coated, and working in vacuum, is described and has a theoretical resolving power of 70 Å, although this is unlikely to be achieved in practice. Two photographs are reproduced. Possible applications of X-ray microscopy in biology and chemical analysis are discussed. R. W. FISH

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533

8774. The production of intense electron flashes. W. SCHAAFS. *Z. Naturforsch.*, **5a**, 132–6 (*March*, 1950) *In German.*

Describes apparatus and techniques for use in electron interference studies, the investigation of the electronic magnetic moment and for high-speed oscillography. A discharge is established between an iron point and a tubular anode. A Lenard window forms the base of the hollow anode. A capacitance of, e.g., 0·03 μF charged to 100 kV is discharged through the tube in about 1 μsec. Magnetic focusing is used to concentrate the electrons in the anode. Charge packets of the order 10^{-7} coulomb are produced. Methods of measurement are discussed. The duration of the packets was found to be $5{\cdot}0 \pm 0{\cdot}5 \times 10^{-8}$ sec. A. H. W. BECK

537.533 : 621.384.6

8775. Extraction of the electron beam from a 30-MeV. synchrotron. J. D. LAWSON, H. E. WALFORD AND J. H. ARAM. Letter in *Nature, Lond.*, **166**, 234–5 (*Aug.* 5, 1950).

537.533.72

8776. Calculation of the optical constants of strong magnetic electron lenses. W. GLASER. *Ann. Phys., Lpz.*, **7** (*No.* 5) 213–27 (1950) *In German.*

Expressions are derived for the focal length, magnification, chromatic aberration and aperture defect of the strong magnetic lenses used in electron microscopy. The process of computation of the electron-optical constants is reduced to the solution of an eigen-value problem. M. R. HOPKINS

537.533.72

8777. Velocity and two-directional focusing of charged particles in crossed electric and magnetic fields. I. N. SVARTHOLM. *Ark. Fys.*, **2**, *Paper* 20, 195–207 (1950).

Field systems with cylindrical symmetry are treated mathematically by the path equation method. Equations are calculated for the equipotentials of electric and magnetic fields, both having cylindrical symmetry with respect to the z-axis and mirror symmetry with respect to the xy-plane; the field strengths are expressed by series expansions in annular regions. Non-relativistic equations of motion of particles in such fields are solved, and conditions for radial, axial, double directional and velocity focusing are given generally and with special cases. Aberrations are calculated, and it is shown that there is an important special case of a cylindrical combination which gives both 1st-order velocity focusing and 2nd-order 2-directional focusing. The conditions are $\alpha_1 = \frac{1}{4}$, $\beta_1 = \frac{1}{2}$, $\beta_2 = 2\alpha_2 + \frac{1}{2}$, where α_n, β_n are the coefficients in $E(r) = E_0(1 + \beta_1\rho + \beta_2\rho^2 + \ldots)$, $H(r) = H_0(1 + \alpha_1\rho + \alpha_2\rho^2 + \ldots)$ and $\rho = (r - r_0)/r_0$. T. G. PICKAVANCE

537.533.72

8778. An emission microscope for photo-electron autoradiography. A. N. BARKER, H. O. W. RICHARDSON AND N. FEATHER. Letter in *Research, Lond.*, **3**, 431–2 (*Sept.*, 1950).

537.533.72

8779. A sector-type double-focusing magnetic spectrometer. E. S. ROSENBLUM. *Rev. Sci. Instrum.*, **21**, 586–92 (*July*, 1950).

An analysis is made of the focusing characteristics of a magnetic spectrometer having an annual magnetic field which varies approximately with $1/r^{\frac{1}{2}}$, thus permitting axial as well as radial focusing of particles of a given energy. By considering the field angle and source location as independently variable, the analysis provides for an instrument more flexible in use than similar existing types. An optical analogy is developed from which a first approximation to the field shape is made, and from which the source and image location, magnification, dispersion and resolution can be readily obtained. Information thus obtained, combined with the results of an investigation into the image shape based on a series expansion, through second order, of expressions for the field strength and particle co-ordinates, yields more detailed information on the field shape which gives optimum focusing conditions and resolution for any chosen set of initial conditions. Comparisons are made with the homogeneous field spectrometer and with the spectrometer of Svartholm and Siegbahn. A.

537.533.72 : 539.165

8780. A β-spectrograph of large dispersive power. J. LAFOUCRIÈRE. *C.R. Acad. Sci., Paris*, **231**, 137–9 (*July* 10, 1950) *In French.*

Continuation of previous theoretical work [Abstr. 2506 (1950)]. The special case in which $H \propto r^{-1}$ is discussed. Trochoidal focusing may be achieved, together with arbitrarily large dispersive power, and an aperture of $\pm 30°$ in the direction perpendicular to the magnetic field. B. ROSE

537.533.72 : 539.165

8781. A large β-spectrometer with two-directional focusing for precise measurements of nuclear radiation. A. HEDGRAN, K. SIEGBAHN AND N. SVARTHOLM. *Proc. Phys. Soc., Lond. A*, **63**, 960–86 (*Sept.*, 1950).

The magnetic field form is discussed and also the arrangement to measure the value of the field continuously with an appropriate accuracy. The difficulties due to electron straggling in the β-source or converter are emphasized, and this effect is for the moment the factor which prevents the full utilization of the high resolving power of the apparatus. A number of typical spectra are given. A.

537.533.72 : 539.165

8782. Experiments with a magnetic lens spectrometer, employing post-focusing acceleration: the L-Auger lines of thorium-active deposit. D. K. BUTT. *Proc. Phys. Soc., Lond. A*, **63**, 986–93 (*Sept.*, 1950).

A post-focusing electron accelerator has been developed to reduce the absorption of low-energy electrons by the Geiger counter window of a β-ray lens spectrometer. Its useful range is for β-rays having energies between 0 and 30 keV, and although, in general, for a portion of this range only partial transmission will be obtained, correction curves for the absorption can be accurately determined. In order to test the spectrometer, an investigation of the *L*-Auger lines of thorium-active deposit has been made. An identification of the lines has bee attempted.

537.533.72 : 539.

8783. Increase of contrast in electron microscop J. HILLIER AND E. G. RAMBERG. *Z. angew. Phys.*, (*No.* 7) 273–8 (1950) *In German.*

The relationship between contrast and scatteri power is discussed and it is concluded that son increase in contrast may be obtained by the use small objective apertures. For thin specimens t increase is limited. For thick ones a greater increa is obtainable, but there is in general no increase resolution. It is considered that increase in contra is better effected by attention to methods of specim preparation, for example by the use of heavy met staining, shadow casting, thin sections, etching a shadow cast replicas. J. THEWI

537.533.72 : 621.385.8

8784. Electron microscopy in the United State W. W. MACDONALD. *Electronics*, **23**, 66–9 (*Au* 1950).

A review of applications and progress. Und headings of schools and hospitals, industry, a government, some 65 applications, some appeari under more than one heading, are shown. Over extracts are given from statements of research group medical and chemical; industrial users, such battery, powder, oil, and other companies; a government departments such as health and medi services. These extracts indicate successful attempted usages. Amongst 9 specific suggestio from users for improvements to the instrument a greater flexibility in variation of the magnificati range; increased resolving power; higher voltage f greater sample penetration; and more precise focusi Photographs of early and recent models are given. H. G. M. SPRATT

537.533.72 : 621.385.8

8785. Reduction of the spherical aberration of ma netic electron lenses. U. F. GIANOLA. *Proc. Ph Soc., Lond. B*, **63**, 703–8 (*Sept.*, 1950).

The dependence of the resolving power of t asymmetrical bell-shaped magnetic field on the le parameters is examined for varying degrees of fi asymmetry. It is shown that a high asymmetry ind favours high resolution, and a preferable value lens power is specified. By suitably reinforcing t lens field with that of a small air-cored coil, t theoretical resolving power of the lens is increas On account of the small size of the coil, the coil curr must be pulsed intermittently if an appreciable re forcing field is to be produced. The basic fact governing the design and operation of a suitable c are discussed.

537.533

8786. A modification to Gabor's proposed diffract microscope. M. E. HAINE AND J. DYSON. Letter *Nature, Lond.*, **166**, 315–16 (*Aug.* 19, 1950).

Electron diffraction patterns of an object obtai with a highly coherent electron source can be rec structed in an optical system to yield an image w improved resolution. This suggested modificat uses an electron microscope, inserts the object in

normal position before the objective lens, and modifies the source to give a coherent illuminating beam. The state of focus is shown to be relatively unimportant in yielding the increased resolution. [See also Abstr. 8667 (1950)]. R. W. FISH

537.533.73

8787. Some effects of nozzle design on the diffraction of electrons by gases. R. B. HARVEY, F. A. KEIDEL AND S. H. BAUER. *J. Appl. Phys.*, **21**, 860–74 (*Sept.*, 1950).

An evaluation has been made of some of the errors introduced into the electron diffraction of gases by failure of the sample to be localized, and by secondary and higher order scattering. Of the nozzles tested, better "image to background" ratios were obtained with the "hydrodynamic" and "comparison" nozzles than with the "conventional" nozzle, but the gas must be admitted slowly enough so that less than about 10% of the main beam is appreciably scattered. The "image to background" ratios were always higher using adequate cooling on the condensing surfaces surrounding the nozzle. On the basis of these results some general design suggestions for electron diffraction cameras, and requirements for good efficiency in nozzles can be made. A nozzle design is proposed which would reduce materially the errors normally encountered in electron diffraction work. A.

537.533.73 : 539.13

8788. Molecular diffraction attachment for RCA microscope. B. O. HESTON AND P. R. CUTTER. *Rev. Sci. Instrum.*, **21**, 608–12 (*July*, 1950).

A new device for the distribution of vapours across an electron beam for molecular diffraction studies is described. The efficiency of the new method has made it possible to obtain molecular diffraction patterns with an electron microscope without need of alterations. The vapours are ejected from a circular crest of a diffusion box immediately surrounding the beam to give a heavy concentration of vapours in contact with the beam while releasing a small amount of vapour. The method has been standardized with well-known patterns of CCl_4 and CBr_4. A.

537.533.73 : 548.74

8789. Why is a Kikuchi band bounded by two sharp edges? K. ARTMANN. *Z. Phys.*, **126** (*No.* 6) 533–47 (1949) *In German.*

A mathematical treatment of the theory of Kikuchi bands which supplements previous work [Abstr. 6252 (1949)] by the same author. Eigenfunctions of free electrons in the crystal are taken into account whereas, previously, bound electrons only were considered. M. R. HOPKINS

537.533.74

8790. On the scattering of slow electrons by solid aluminium surfaces. O. KRENZIEN. *Z. Phys.*, **126** (*No.* 6) 598–600 (1949) *In German.*

The coefficient of reflection of 5–10 eV electrons is measured for freshly evaporated Al surfaces and found to be much lower (0·15–0·22) than is reported in the literature. If the Al is, however, allowed to stand in dry O for only a few hours at room temperature, the coefficient of reflection increases to the previously reported value of about 0·6. This is believed to arise from the formation of an oxide layer. J. THEWLIS

537.533.74

8791. Non-elastic scattering of electrons penetrating through metals. A. YA. VYATSKIN. *J. Exp. Theor. Phys., USSR*, **20**, 557–65 (*June*, 1950) *In Russian.*

The non-elastic scatter of electrons (non-relativistic energies) in metals due to Coulomb interaction with the lattice electrons is investigated theoretically. It is concluded that the path of scatter (free path) of electrons of medium energies (100 eV–2×10^3 eV) is approx. independent of their energy, and that the total path length (braking) $\propto$ the energy; a strong relation between scatter path and lattice constant of the crystal ($\lambda \simeq 1/a^4$) is also established. The problem is solved by the introduction of the "period of non-elastic scatter" after the lapse of which the probability of the electron being in the initial condition as a result of Coulomb interaction with one of the lattice electrons, has decreased e times (i.e. the intensity of a monochromatic beam has fallen e times). Only a single scattering process of the electron is considered. The solution of the system of Dirac's equations yields the non-elastic scatter period which, multiplied by the probable velocity, leads to the length of the scatter path. The relation between scatter path and damping coefficient was also established. The few experimental results available agree very well with those of the theory. B. F. KRAUS

537.533.74

8792. Experimental study of the scattering of β-rays in metal foils. J. VERHAEGHE AND J. ALLEWAERT. *C.R. Acad. Sci., Paris*, **231**, 135–7 (*July* 10, 1950) *In French.*

Measurements were made in a Wilson chamber of the multiple scattering of ~ 1 MeV electrons by Cu, C and Au. The angular distribution functions had the Gaussian shape predicted by the theory of Williams [Abstr. 3037 (1940)]. In the 2 cases (out of 4) in which the mean scattering angle was $> 15°$, it was $<$ that calculated from the theory, with an additional assumption on averaging over different values of the electron momentum. B. ROSE

537.533.74

8793. The effect of nuclear structure on the elastic scattering of fast electrons. L. R. B. ELTON. Letter in *Phys. Rev.*, **79**, 412–13 (*July* 15, 1950).

537.533.74

8794. Study of electron-electron scattering. G. GROETZINGER, L. B. LEDER, F. L. RIBE AND M. J. BERGER. *Phys. Rev.*, **79**, 454–8 (*Aug.* 1, 1950).

In the course of various cloud-chamber investigations pictures of 98 electron-electron collisions were obtained, in which the primary electrons ranged in energy approximately from 0·05 to 1·7 MeV and the deflections (in the centre-of-mass system) exceeded 32°. By means of a statistical test suitable for the systematic evaluation of heterogenous data, a comparison was made of our results with the theory of Møller, relativistic versions of the theories of Mott and Rutherford, and the classical non-relativistic Rutherford theory. Our data discriminate definitely only against the latter theory. When combined with 122 electron-electron collisions observed by Champion, they are consistent only with the first two theories, but are insufficient to discriminate decisively between them. A.

537.533.75

8795. An explanation of the absorption law for β-rays. H. DÄNZER. *Z. Phys.*, **128** (*No.* 1) 79–103 (1950) *In German.*

The theory of the slowing down and diffusion of neutrons in media is applied to the absorption of β-rays, using as collision length the reciprocal of the Lenard absorption coefficient. Good agreement with experiment is found in the region 100–660 keV. In the range 0·3 to 1 MeV, the relation $R_p = \sqrt{2}R_0$ between the range R_p and the collision length R_0 holds. A wave-mechanical calculation of the elastic scattering of electrons is in good agreement with experiment. J. HUGHES

537.533.8

8796. The role of the surface and volume effects in the secondary electron emission of metals. A. YA. VYATSKIN. *J. Exp. Theor. Phys., USSR*, **20**, 547–56 (*June*, 1950) *In Russian.*

The secondary electron emission of metals is considered as composed of additive effects, viz. the "surface" effect due to the influence of the potential barrier of the surface, and the "volume" effect due to the action of the periodical space field of the metal lattice. The volume effect produces the supplementary maxima of the distribution function of the secondary electrons (fine structure) and also produces the maximum and fall of the curve of the emission coefficient v. energy of the primary electrons.

B. F. KRAUS

537.533.8

8797. Measurement of secondary electron emission from dielectric surfaces. H. L. HEYDT. *Rev. Sci. Instrum.*, **21**, 639–43 (*July*, 1950).

The dielectric surface is bombarded by primary electrons having energies which produce a secondary emission ratio greater than unity. This establishes the surface potential at a known value. With the known potential difference between the dielectric surface and primary electron source, the energies of the primary electrons are automatically determined for the first instant of surface bombardment. The net current to the dielectric surface at any moment is measured by using a cathode-ray oscillograph to observe the transient current to a metal plate which backs the dielectric. The method has been used to study metallic surfaces and has yielded results which agree very closely with those obtained using the conventional d.c. method of measurement. A.

537.533.9

8798. Radiation of the superlight type on the passage of charged particles through ferromagnetics. D. IVANENKO AND V. GURGENIDZE. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 997–9 (1949) *In Russian.*

537.533.9 : 541.182.63

8799. Motion picture studies of electron bombardment of colloidal crystals. J. H. L. WATSON AND L. E. PREUSS. *J. Appl. Phys.*, **21**, 904–7 (*Sept.*, 1950).

Phenomena not seen or recorded by orthodox methods are observed on the large number of micrographs which are taken during a motion picture experiment, and reaction times as short as 0·03 sec can be calculated. The technique is useful for investigating solid-liquid-solid changes both by direc observation and by recording Bragg reflections. I most cases a preliminary effect of electrons upc crystals is to drive off water. In the case of NaC crystals a residual envelope is left. Inside this, sma particles, both solid and liquid, are observed to mov rapidly due, it is believed, to a combination c Brownian movement and convection. These gradual evaporate and diffuse through the wall. The poss bility is discussed that the residual envelope is forme by contamination. Examples are also taken fro bombarded colloidal crystals of WO_2.

537.533.9

8800. Isotope effect on bond rupture by electro impact on hydrogen, deuterium, and tritium. O. A SCHAEFFER AND J. M. HASTINGS. *J. Chem. Phys.*, **18** 1048–50 (*Aug.*, 1950).

The relative yields by electron impact of atom and molecular ions, x^+/x_2^+ ratios, from H, D and have been measured with a 60° sector type mas spectrometer. It is shown that the major part of th previous disagreement between calculated and observe values can be understood on the basis of voltag discrimination by the ion source. By using magnet scanning and a high ion accelerating voltage th experimental ratios are: $H^+/H_2^+ = 0{\cdot}013$, $D^+/D_2^+ = 0{\cdot}0070$, $T^+/T_2^+ = 0{\cdot}0036$ for 30 V electrons. Thes are to be compared with the calculated ratio $H^+/H_2^+ = 0{\cdot}016$, $D^+/D_2^+ = 0{\cdot}0072$, $T^+/T_2^+ = 0{\cdot}0038$.

537.534.72 : 539.155

8801. A mass spectrometer for the determination isotope abundance ratios. E. W. BECKER, E. DÖRNEN BURG AND W. WALCHER. *Z. angew. Phys.*, **2** (*No.* 261–6 (1950) *In German.*

Description of a 60° mass spectrometer wit magnetic scanning. The ions are produced b electrons oscillating in an anode space between tw cathodes. The instrument is distinguished by larg ion currents (10^{-9} A) and high stability. Th resolving power is 250. H. LONDO

537.534.72 : 539.155

8802. Ion optics of the mass spectrometer. *Tek Tidskr.*, **80**, 679–81 (*Aug.* 12, 1950) *In Swedish.*

A magnetic sector field is considered and the pat of a particle with given charge, mass and velocity determined, first provided its entrance velocity normal to the boundary diameter, next for an arbitra entrance velocity. A sector of angle $< 180°$ is dea with and a geometric-optical description of partic paths is given leading to a definition of focus an dispersion. An electrical sector field is described an the combination of electric and magnetic fields to mass spectrometer is established. J. A. WILCKE

537.534.72 : 539.155

8803. A transit-time prism for isotope separatio H. HEIL. *Z. Phys.*, **28** (*No.* 1) 36–46 (1950) *In Germa*

Discussion of an instrument similar to the "Isotron [H. D. Smyth, *Atomic Energy for Military Purpose* Princeton (1945) p. 197]. Ions accelerated by potential U_0 travel through a Faraday cage, th potential of which varies with time in a saw-toot manner. Since the time of passage depends on th mass of the ions their energy when entering a spac

of constant potential will differ accordingly and ions of different mass can subsequently be separated by a deflecting or retarding electric field. The Faraday cage can be considered as the analogue to an optical prism, with one spatial co-ordinate replaced by time. The correct time variation for good resolution is calculated and the effects of space charges and gap widths between the spaces at different potentials are discussed. The advantages claimed with reference to the mass spectrometer are, apart from the savings on the magnet, that there are no limitations to the cross-section of the beam and that higher current densities can be employed. The power consumption is estimated to be less than 900 kWh per mol. H. LONDON

537.534.74

8804. The proton-proton interaction. R. S. CHRISTIAN AND H. P. NOYES. *Phys. Rev.*, **79**, 85–95 (*July* 1, 1950).

This paper presents a phenomenological analysis of the *p-p* scattering observed at 32 and 340 MeV in terms of static nuclear potentials. Comparison of these results with the *n-p* scattering at 40, 90 and 280 MeV analysed previously indicates that nuclear forces are not charge-independent. In particular, there is definite evidence in the *n-p* scattering data that but little scattering occurs in the odd parity states, whereas the high *p-p* cross-section apparently must be due to scattering in the (odd parity) triplet states (this holds true even if velocity-dependent spin orbit forces, i.e. $\sigma \cdot \mathbf{L}$, are included). It is possible that the radial dependences found necessary for *p-p* scattering would be acceptable for the *n-p* scattering even though the exchange behaviour is different. No large repulsive forces have shown up in either the *n-p* or the *p-p* system of sufficient magnitude to account for nuclear saturation if saturation is to be predicted from two body forces. In both cases they would have been very easily detected, independent of the potential model assumed. A.

537.534.75

8805. Ratio of cross sections for electron capture and electron loss by proton beams in metals. T. HALL. *Phys. Rev.*, **79**, 504–12 (*Aug.* 1, 1950).

Measurements have been made of the ratio of the charged to the neutral component (protons to hydrogen atoms) in hydrogen ion beams of energies between 20 and 400 kV, passing through the metallic media Be, Al, Ag and Au. The data show that this ratio is the same, within the accuracy of the experiment, for the three lighter elements, but is slightly less in Au above 100 kV. The curves depicting this ratio as a function of ion speed cannot be fitted by a power law over the entire energy range, but the high energy end of the data can be fitted fairly well in this way. At 350 kV, the slopes correspond to a dependence on ion speed v of the form v^9 in the case of the lighter elements, and v^7 in the case of Au. The cross-sections for electron capture and electron loss are found to be equal at an ion energy of 26 kV. The ion then has a speed 0·95 times that of the H orbital electron ($e^2/\hbar$). A.

537.534.75

8806. Loss of energy of fast protons in matter with particular reference to their range in carbon. A. E. TAYLOR. Letter in *Phil. Mag.*, **41**, 966–8 (*Sept.*, 1950).

DISCHARGE TUBES . COUNTERS 537.54

537.542 : 537.534

8807. The development of a magnetic ion-source with high ionisation efficiency. P. C. VEENSTRA AND J. M. W. MILATZ. *Physica*, **16**, 528–36 (*June*, 1950).

Starting from the principle given by A. Th. Finkelstein [Abstr. 1957 (1940)], M. von Ardenne [Abstr. 555 (1946)] and W. Maas [Thesis, Utrecht (1948)], further development of the magnetic ion-source has been undertaken. The instrument has been designed especially for use with a 800 kV neutron generator described by W. Maas and under normal operating conditions the source will have an output of 1 mA ion current. After increasing input power several milliamperes may be obtained. The principal advantages of the magnetic source are: power can be obtained from storage batteries, so that the source and supply can be put at high potential with respect to earth; no artificial cooling is required; gas-pressure and hence gas-consumption are low; a beam homogeneous with respect to ion velocity is obtained. A.

537.542

8808. The behaviour of counters filled with pure vapours in the Geiger and proportional regions. E. FÜNFER AND H. NEUERT. *Z. angew. Phys.*, **2**, (*No.* 6) 241–9 (1950) *In German.*

Measurements of pulse length and of the variation of pulse height with applied voltage made with vapour-filled counters (e.g. methanol, ethanol, methylal, ethyl acetate) showed that the counters had a longer proportional region than when filled with a gas-vapour mixture; for beta-particles the max. amplifying factor was 10^6–10^7. With alpha-particles the proportional region is followed, with increasing voltage, by a "limited-proportional" region, in which the amplitude is reduced by space-charge effects. "Giant" (übergross) pulses can be produced by radial alpha-particles (and under extreme conditions by beta-particles) either in the proportional region or in the Geiger region, depending on experimental conditions; they are longer by about a factor of 10 than the proportional pulses. A. O. STANESBY

537.542

8809. Effect of density and average atomic number of the medium on the counting yield of beta and gamma radiation in a solution-type Geiger counter. R. S.-H. CHIANG AND J. E. WILLARD. *Science*, **112**, 81–4 (*July* 21, 1950).

Tests with standard solution type counter, filled with tetramethyl lead, showed in general that for beta-(gamma)-emitters the counting efficiency decreases (increases) with increasing density and with increasing average atomic number of the solution. With gamma-emitters, the counting efficiency is independent of the solution if the wall thickness of the counter is sufficient to stop all photo-electrons produced in the solution. A. O. STANESBY

537.542

8810. Temperature dependence of counter characteristics in self-quenching Geiger-Müller counters. W. R. LOOSEMORE AND D. TAYLOR. Letter in *Proc. Phys. Soc., Lond. B*, **63**, 728–9 (*Sept.*, 1950).

537.542

8811. Geiger–Müller counter with xenon–oxygen filling. O. RIEDEL. *Z. Naturforsch.*, **5a**, 331–2 (*June*, 1950) *In German.*

A G.M. counter (Al cathode, 2 cm dia., 3 cm long; anode, 0·2 mm dia. steel wire) was self-quenching when filled with a Xe-O_2 mixture (optimum 60 mm Hg of Xe + 0·02 mm O_2), but the slope of the plateau was high (1%/V); this was reduced to 0·04%/V by using a Neher–Harper quench circuit. The counter has a very long effective life. A. O. STANESBY

537.542

8812. Windowless flow type, proportional counter for counting C^{14}. C. V. ROBINSON. *Science*, **112**, 198–9 (*Aug.* 18, 1950).

537.542

8813. Hydrogen-filled Geiger counters. B. COLLINGE. *Proc. Phys. Soc., Lond. B*, **63**, 665–74 (*Sept.*, 1950).

Permanent gas counters are discussed and a new quenching circuit is described. Quenching times of about 45 μsec have been used, and plateaux with slopes better than 0·05% per volt obtained. A formula for the correction of counting rates for losses caused by the counter dead-time has been confirmed within wide limits. It has been found possible to measure counting rates as high as 5×10^5 counts per minute with an accuracy closer than 1%. A.

537.542

8814. Ethyl formate as a quenching agent in Geiger–Müller counting tubes. F. G. MORRIS. *J. Sci. Instrum.*, **27**, 254 (*Sept.*, 1950).

537.542

8815. Calibration of proportional counters by the excitation of fluorescence radiation with radioactive sources. G. M. INSCH. *Phil. Mag.*, **41**, 857–62 (*Sept.*, 1950).

Calibration by means of a very few suitably chosen radioactive sources which are used to excite the fluorescence X-radiation of various elements is described. The efficiency of excitation is high and the method is of wide application. The accurate identification of isomeric transitions using proportional tubes is demonstrated. A.

537.542 : 537.531 : 539.166

8816. Proportional counters in a magnetic field: an investigation of the isomerism of Br^{80} and a measurement of the fluorescence yield of krypton. D. WEST AND P. ROTHWELL. *Phil. Mag.*, **41**, 873–89 (*Sept.*, 1950).

See also Abstr. 7478 (1950). The proportional counter technique for measuring the energy of soft electrons has been extended to include higher energy radiations by placing the counter in a strong magnetic field. Suitable X-ray calibration sources consisting of long-lived *K*-capture bodies which give lines at energies up to 50 keV have been developed. In an application of the technique to a study of the isomerism of Br^{80}, the conversion coefficient of the 37 keV gamma-ray was found to be 1·2, which is close to the calculated value for an electric dipole transition. In a second application, the fluorescence yield of the *K* shell of krypton was measured as 0·67. A.

537.542 : 539.165.08

8817. A counter tube for the measurement of the range curve of α-rays. B. GYSAE. *Z. Naturforsch.* **5a**, 403–4 (*July*, 1950) *In German.*

537.542 : 621.387.42

8818. Geiger counter for lectures. R. L. IVE *Electronics*, **23**, 105–7 (*July*, 1950).

The electrical and mechanical construction of Geiger counter for demonstration purposes, capab of 50 W audio output at 1 000 counts/sec with goo s./n. ratio, is described in detail. Two auxilia indicators are used, a Strobotron flasher and a thy ratron rate meter. A. LANDMAN (

537.542 : 539.165 : 548

The crystal counter in the investigation of β- an γ-rays. *See Abstr.* 8960

537.54

8819. BF_3 neutron counters. A. BRACCI, U FACCHINI, E. GERMAGNOLI AND E. ZIMMER. *Nuov Cim.*, **7**, 512–19 (*July* 2, 1950) *In Italian.*

Characteristic properties of some BF_3 and A-BF proportional counters for slow neutrons are describe

537.542 : 539.16.08 : 621.386.8

8820. Experimental direct reading X-ray dosage ra meter for laboratory use. W. B. LURIE. *Cat Press*, **7**, 22–5 (*Summer*, 1950).

This is a portable, self-contained meter covering wide range of intensities and wavelengths. It permi the measurement of the direct output of tubes an location of leakage radiation. Two ionizatio chambers (1 cm^3 and 200 cm^3) are used, the windo being very thin cellulose acetate sheet coated wit aquadag. The circuit is given. For details s Abstr. 2568 B (1950) [*Electronics*, **23**, 74–7 (*Marc* 1950)]. W. SUMMER (

537.54

8821. Energy dependence of the naphthalene scin tillation detector. J. C. SMELTZER. Note in *Rev. Sc Instrum.*, **21**, 669 (*July*, 1950).

537.54

8822. Scintillations from naphthalene-anthracen crystals. J. B. BIRKS. Letter in *Proc. Phys. Soc Lond. A*, **63**, 1044–6 (*Sept.*, 1950).

537.542 : 539.166 : 535.3

8823. Fluorescence of liquids under gamma bom bardment. H. KALLMAN AND M. FURST. *Nucleonic* **7**, 69–71 (*July*, 1950).

The light efficiencies of a number of organic pho phors in solutions excited by gamma-rays ar measured by means of a photomultiplier are tab lated. The materials include anthracene, terpheny diphenylbutadiene, diphenylhexatriene, alpha- ar beta-naphthylamine and durene, the solvent phenylcyclohexane, xylene, iso-durene, *p*-dioxane ar benzene. The best light yields were obtained with t *p*-terphenyl solutions and with phenylcyclohexane solvent. Data are also given for the relative fluore cence of the solid phosphors and for the absorptio of the fluorescent light in the solutions. Very sm amounts of impurity in the solutions were found increase absorption. L. R. SHEPHE

537.542 : 621.318.5

8824. Scaling circuits. I. GABRIELLI AND POIANI. *Tecn. Ital.*, **5**, 173–8 (*May–June*, 1950) *Italian.*

A description is given of known types of counti

circuits using pairs of triodes or pentodes. Details are then given, with component values, of a scale-of-128 circuit. V. G. WELSBY (R)

537.542 : 621.318.572

8825. A new type of scale-of-two unit. B. RAMACHANDRA RAO. *J. Sci. Industr. Res.*, **9B**, 185–7 (*Aug.*, 1950).

The triggering of scaling units is effected by the use of a triode as auto-bias as well as input. The circuit is sensitive and reliable in operation. A.

537.542 : 621.318.572

8826. Coincidence circuit for a scintillation detector of radiation. W. C. ELMORE. *Rev. Sci. Instrum.*, **21**, 649–52 (*July*, 1950).

This paper describes a very simple low level coincidence circuit of moderate speed, which is suitable for use with two or more multiplier photo-tubes in a scintillation detector of radiation. The operation of the circuit is analysed, and performance data given to show its effectiveness in eliminating spurious counts due to noise pulses in the photo-tubes. Some useful modifications of the circuit are suggested. A.

537.542 : 621.383.8 : 621.318.572

8827. Scintillation counting equipments. R. B. OWEN AND E. A. SAYLE. *Instn Elect. Engrs, Paper* 1035 (1950) 7 *pp.*

Two types of scintillation counter, employing the VX 5045 multiplier photocell and a phosphor, are described. The alpha scintillation counting equipment is a complete instrument for counting samples of low activity over an area of 10 cm², at background rates of < 2 counts/hr. A counting efficiency of 30% is obtained from a thin alpha-particle source with a comparative accuracy of $\pm 1\%$. The scintillation gamma counter is designed as a probe unit for routine measurement of gamma-ray flux. Methods are given for the preparation of suitable phosphors. Using a thallium-activated NaI phosphor, a counting efficiency of 22·5% was measured for 1·2 MeV gamma-rays stable over long periods to $\pm 1\%$. A.

537.542 : 621.395.645

8828. A linear preamplifier for driving a long coaxial cable. L. G. LEWIS, J. G. ROBINSON AND J. TOLL. *Rev. Sci. Instrum.*, **21**, 593–6 (*July*, 1950).

The circuit's response characteristics permit impedance matching of the coaxial line without sacrificing linearity of response, and make possible a relatively long line between the particle detector and the recording apparatus. The circuit was found to be reasonably stable for long periods of time, even under severe outdoor operating conditions. A.

IONIZATION . THERMIONICS 537.56/.58

537.56 : 537.523.4

8829. The irradiation of spark gaps for voltage measurement. D. R. HARDY AND J. D. CRAGGS. *Trans Amer. Inst. Elect. Engrs*, **69** (*Pt I*) 584–90 (1950).

Currents produced in various spark gaps (spherical and parallel-plate) due to irradiation by (*a*) ultra-violet light, and (*b*) radioactive sources, were measured for different conditions of electrode surface and for different locations of the radioactive material. Effects of radium capsules enclosed in the electrodes, and of the use of a radioactive Co cathode, were examined. It was concluded that in general radioactive substances provide a more satisfactory means of irradiation than ultra-violet light. F. LLEWELLYN JONES

537.561

8830. The ionization potential of cyclopropane of electron impact. F. H. FIELD AND E. A. HINKLE. Letter in *J. Chem. Phys.*, **18**, 1122–3 (*Aug.*, 1950).

537.563

8831. Dissociation and ionization of acetone and acetic acid molecules by electron impacts. T. KAMBARA. *J. Phys. Soc. Japan*, **5**, 84–90 (*March–April*, 1950).

The nature and relative abundance of ions produced from acetone with electron impact of 80 eV are reported; CH_3CO^+ with $M/e = 43$ amounts to 43·1%, $(CH_3)CO_4^+$ to 8·4%. In acetic acid CO^+ is most abundant. Appearance potentials were measured, for CH_3COOH^+ it nearly equals, for $(CH_3)_2CO^+$ it is less by 1 eV than, that of alcohol. The non-bonding O electron is ionized first, giving O^+ trivalent character. J. JACOBS

537.565 : 533.58

On the possibility of obtaining low pressures by gaseous ionization. *See Abstr.* 8555

537.568

8832. The charge interchange of ions and atoms of mercury. B. M. PALYUKH AND L. A. SENA. *J. Exp. Theor. Phys., USSR*, **20**, 481–91 (*June*, 1950) *In Russian.*

Measurements of the effective cross-section of electron exchange between Hg ions and atoms were executed in the energy interval of the ions between 32 and 1 400 eV. In addition to the method of the maintaining field, the methods of constant ionic velocity and of constant collector potential were used; the advantages of the last are demonstrated. Systematic measurements for the ion energies 75, 165, 425 and 990 eV yielded effective exchange cross-sections of 351, 316, 286 and 258 cm²/cm³ per mm Hg column. The measurements for other values of the energy are in good agreement with the results of the systematic measurements and their evaluation yields for the relation between effective cross-section and ion energy a monotonically falling curve which for high velocities slowly tends towards the limit 174 cm²/cm³ per mm Hg column, this being the value calculated without considering the tunnel-effect.

B. F. KRAUS

537.583

8833. On poisoning of oxide cathodes by atmospheric sulphur. H. A. STAHL. *Appl. Sci. Res.*, **B1** (*No.* 6) 397–412 (1950).

Oxide cathodes made from Ba carbonate or from Ba–Sr carbonate mixtures which, after prolonged storage in atmospheric air have been converted into the oxides, yield electron diffraction patterns that point—besides to Ba or Sr oxide, respectively—to the presence of a cubic face-centred space lattice of the lattice constant $d = 6{\cdot}37$ Å upon the surface. This lattice must be attributed to Ba sulphide. The Ba

sulphide coating on oxide cathodes must be assumed to arise from sulphurous and/or sulphuric acid present in the atmosphere, in complete accordance with the results of the air-hygienists' "bell-jar method" that employs Ba carbonate as a detergent for atmospheric sulphur. A few measurements on oxide cathodes sulphurized on purpose evidenced the serious contamination of the cathode. Finally, attention is drawn to the considerable variations of tube emissivities within the same production series, and the possibility is discussed that these variations are influenced by the presence of more or less Ba sulphide on the cathode surface. A.

537.583 : 621.385.032.21

8834. Remarks on the electron emission from metal oxides, alloys and metal carbides. E. KRAUTZ AND G. LAUTZ. *Abh. Braunschw. Wiss. Gesell.*, **2**, 192–8 (1950) *In German.*

Since the emission from complex cathodes depends so much on the history and state of the emitting surface, it is proposed to determine an "optimum" temperature by electron emission microscopy, this being the temperature at which the screen is excited to a constant intensity. Pure Ca, Sr and Ba were used to establish a work function scale. In addition to the alkaline earth oxide, the oxides of iron were investigated. It was found that the emission decreased with increasing oxygen content. Some Ni, Fe, Cr alloys were measured, as were the heavy metal carbides. These gave much smaller emissions than the oxides. Mo_2C gave the highest emission, TaC the smallest.

A. H. W. BECK (R)

COSMIC RAYS 537.591

537.591

8835. The origin of cosmic rays. E. M. MCMILLAN. *Phys. Rev.*, **79**, 498–501 (*Aug.* 1, 1950).

The original idea of Menzel and Salisbury concerning the origin of cosmic rays has been extended and some of its possible consequences worked out in more detail. It is concluded that low frequency electromagnetic waves (a few cycles per second) may exist in limited regions near the outer edge of the solar corona, and could accelerate ions to cosmic-ray energies. An attempt is made to explain both the "ordinary" cosmic rays and the intensity increases following solar flares in terms of the action of these waves. A.

537.591.1

8836. Instrument for directional studies of cosmic-ray intensity. H. W. BOEHMER AND J. E. COOLIDGE. *Rev. Sci. Instrum.*, **21**, 633–8 (*July*, 1950).

In this dual cosmic-ray telescope each bank of the telescope consists of 5 counter trays with 9 Geiger counters in each tray. The electronic circuits are connected to give 3 triple consecutive coincidence trains: 1, 2, and 3; 2, 3, and 4; 3, 4, and 5. By the insertion of 8 centimetre-thick lead blocks covering the sensitive area of a Geiger tray between trays 3 and 4, and 4 and 5, a separation of the components of the radiation is possible. The telescope is adjustable in zenith in 15 degree intervals from 0 to 75 degrees from the vertical. However, in azimuth, in order t investigate asymmetry characteristics, 2 position 180 degrees apart are employed. The control of th telescope is entirely automatic. It changes in zeni and in azimuth every 40 minutes, the changes i zenith and azimuth being displaced 20 minute A cycle of operation, which consists of the step chang in zenith from 0 to 75 degrees with the associate alternate azimuthal changes, requires 4 hours.

537.591.

8837. Cosmic ray intensity in the upper atmosphere M. PANETTI AND G. WATAGHIN. Letter in *Phys. Rev* **79**, 177–8 (*July* 1, 1950).

A semi-empirical description of the total cosmic-ra particle intensity in the upper atmosphere is given i terms of the fast nucleon component (survival c primary protons, secondary nucleons from proton nucleons from α-particles), the local (slow) nucleo component, and the meson (π-, μ- or decay electron component. The remaining electron-photon com ponent is considered to be adequately covered.

J. G. WILSO

537.591.

8838. Heavy nuclei from primary cosmic radiatio observed in photographic plates exposed at 29 000 m above sea level. M. M. ADDARIO AND S. TAMBURINO *Nuovo Cim.*, **7**, 389–400 (*July* 2, 1950) *In Italian.*

Tracks produced by heavy nuclei with atomi number $Z > 2$ have been observed. For 35 of th observed nuclei the atomic number, the energy mini mum in the stack of plates, the energy minimum pe nucleon on entering the atmosphere have bee calculated. The flux distribution of the heavy nucl *v.* zenith angle and the distribution of the heav nuclei *v.* atomic number have been plotted. It seem evident that these heavy nuclei are a component o the primary cosmic radiation. Two particular event are discussed: (1) the partial disintegration of a heav nucleus in the glass between two emulsions; (2) th nuclear collision of a heavy nucleus with a nucleu of the emulsion. A

537.591.

8839. The electrons in cosmic rays. C. L. CRITCH FIELD, E. P. NEY AND S. OLEKSA. Letter in *Phys. Rev.* **79**, 402–3 (*July* 15, 1950).

537.591.

8840. Magnetic cloud-chamber analysis of cosmi rays at 3·4 kilometers. C. E. MILLER, J. E. HENDER SON, D. S. POTTER, J. TODD, JR. AND A. W. WOTRINO *Phys. Rev.*, **79**, 459–66 (*Aug.* 1, 1950).

About 18 000 magnetic cloud-chamber photograph (magnetic field of 8 000 gauss) have been taken at a altitude of 3·4 km at Climax, Colorado. These wer counter-controlled with single counters above an below the chamber forming a twofold telescope. Th photographs were taken under three conditions: wit no absorber over the chamber, and with 5 and 20 c of lead above the chamber. The momenta of singl occurring particles have been measured and plotte to give momentum distributions. With sufficien absorber over the chamber, selection of exposure showing a single track has the effect of eliminatin electrons. The momentum spectrum of the residu particles (mesons and some protons) shows a di

tribution closely similar to that found for mesons at sea level. Contrary to previously published reports, no appreciable increase in the relative number of low energy mesons is found. Particles selected in this way show a positive to negative ratio of $1{\cdot}5 \pm 0{\cdot}05$ as compared to reported values of about 1·3 at sea level. This confirms previous reports of an increase in this ratio with altitude. However, it is shown that the increase in positive excess is due in part to a greater number of protons at higher altitudes, and it is suggested that the entire increase may be thus accounted for, the positive excess of mesons remaining constant with altitude. Some estimate has been made of the abundance of protons at 3·4 km. A.

537.591.15

8841. Nuclear cascade process and its role in the development of wide atmospheric showers. G. T. Zatsepin. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 993–6 (1949) *In Russian.*

537.591.15

8842. Measurement of density spectrum of wide air showers with the help of ionization chambers. M. I. Podgoretski. *Dokl. Akad. Nauk, SSSR*, **67** (*No.* 6) 1005–8 (1949) *In Russian.*

537.591.15

8843. Contribution to the study of extensive showers. E. Amaldi, C. Castagnoli, A. Gigli and S. Sciuti. *Nuovo Cim.*, **7**, 401–56 (*July*, 1950) *In Italian.*

A research devoted to comparing the behaviour of the soft component of extensive air showers with the theoretical results derived from the usual electronic cascade theory. The existence of mesons and nucleons in extensive air showers suggests that such a theory cannot give an adequate representation even of the soft component of the shower. The experimental device, consisting of 4 ionization chambers and 4 sets of counters in coincidence, makes use of the multiplication of the soft component of the impinging extensive showers in a Pb layer (2·5 or 5 cm thick) surrounding the ionization chambers. The results of some preliminary measurements are compared with the results of numerical calculations. These last have been performed assuming that in an extensive air shower the spatial distribution of electrons and photons of a given energy, can be represented by a Gaussian law, modified with respect to that used by other authors. This type of representation of the structure of the showers is compared with other more accurate structure functions. The discrepancy between the experimental results and the theoretical calculations is not large, mainly on account of the large statistical errors. The authors attribute this discrepancy to the actual structure of extensive air showers. A.

537.591.15

8844. Penetrating showers generated in lead and carbon. L. Mezzetti and R. Querzoli. *Nuovo Cim.*, **7**, 470–81 (*July*, 1950) *In Italian.*

The dependence of the generation cross-section of penetrating showers produced by ionizing agents upon the atomic number of the material crossed by the primaries has been studied by an arrangement of G.M. counters which was sensitive to showers of comparatively low penetrating power. The frequencies of penetrating showers generated in relatively small thicknesses of Pb and C have been compared and a value $\lambda_{Pb}/\lambda_C = 4{\cdot}4 \pm 1{\cdot}0$ for the ratio of the collision mean free paths in Pb and C has been deduced. The dependence of the observed production rate upon the total number of ionizing particles in the shower has been also investigated and compared with theoretical distributions as given by plural-production and multiple-production theories; but the results obtained do not allow of choosing between the theories as to-day formulated. A.

537.591.15

8845. On the lateral spread of extensive air showers. L. Jánossy. *Proc. Phys. Soc., Lond. A*, **63**, 1009–15 (*Sept.*, 1950).

The lateral and angular spread of extensive showers is calculated in an approximation where ionization loss and incomplete screening are neglected. The atmosphere is taken to be homogeneous. It is shown that the spread at the cascade maximum is equal to the average spread, but the spread increases considerably throughout the shower; the above results are in qualitative agreement with results given by Borsellino [Abstr. 4179 (1950)]. The quantitative discrepancy between the results of Borsellino and other authors is commented on. A.

537.591.15

8846. Delayed particles in extensive air showers. C. B. A. McCusker, D. M. Ritson and T. E. Nevin. Letter in *Nature, Lond.*, **166**, 400–1 (*Sept.* 2, 1950).

No evidence was found for particles in air showers delayed between 1·4 and 11·4 μsec. E. P. GEORGE

537.591.3

8847. The penetration of particles associated with cosmic-ray stars. C. G. Montgomery, D. D. Montgomery and J. A. Northrop. *Phys. Rev.*, **79**, 293–6 (*July* 15, 1950).

A survey was made at Climax, Colorado (elevation 3 510 m) of the particles associated with nuclear explosions, of stars, which were capable of emerging from the thin-walled ionization chamber in which the stars were recorded, and of penetrating various thicknesses of Pb absorber. The experiment was so designed as to distinguish between electrons and penetrating particles. It was found that in a small fraction of the nuclear events (1 to 2%) there were associated electrons. In some of these events there were pairs of associated rays capable of penetrating 8 in of Pb placed below the chamber. The absorption in Pb was found to be exponential with a mean free path of 107 ± 30 g/cm². A.

537.591.3 : 778.34

8848. Mean free path of cosmic ray ionizing particles in photographic emulsions. L. Bagalà, M. Merlin and G. Puppi. Letter in *Nuovo Cim.*, **7**, 525–6 (*July*, 1950) *In Italian.*

From the average distance of double stars in photographic emulsions, the mean free path of the primary cosmic-ray particles is found to be 175 g/cm², in fair agreement with results obtained by the Bristol workers. [Abstr. 6622 (1950)]. L. PINCHERLE

537.591.5

8849. Cosmic rays and solar relationships. A. R. Hogg. *J. Atmos. Terr. Phys.*, **1** (*No.* 1) 56–62 (1950).

The paper discusses certain solar and terrestrial

relationships found in a series of observations of cosmic rays made during 1935–40. No regular periodicity corresponding to that of the sun's rotation was observed, although a 27-day recurrence tendency similar to that of terrestrial magnetic disturbance was found. Correlations with formation and central meridian passage of large spots and with flares failed to distinguish any significant effect of a solar phenomenon on cosmic rays unless the solar phenomenon was also accompanied by a magnetic disturbance. A.

537.591.5

8850. Altitude dependence of neutron production by cosmic-ray particles. W. B. FOWLER. Letter in *Phys. Rev.*, **79**, 178–9 (*July* 1, 1950).

537.591.5

8851. The extraordinary increase of cosmic-ray intensity on November 19, 1949. S. E. FORBUSH, T. B. STINCHCOMB AND M. SCHEIN. *Phys. Rev.*, **79**, 501–4 (*Aug.* 1, 1950).

On November 19, 1949, at a mountain station at Climax, Colorado, the intensity increased to about 200% above normal in half an hour. At the sea-level station at Cheltenham, Maryland, the increase was about 43%. No increase occurred at the equator. From the increase in the effect with altitude and latitude, it is concluded that the increase was due to the nucleonic component produced by relatively low energy primary charged particles probably accelerated by some solar mechanism. A.

537.591.5

8852. The semi-diurnal variations of atmospheric pressure and of cosmic-ray intensity. H. D. RATHGEBER. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 920–1 (*Aug.*, 1950).

537.591.5

8853. Lead absorption of cosmic rays at different altitudes near magnetic latitude 22° N. P. S. GILL. Letter in *Nature, Lond.*, **166**, 318–19 (*Aug.* 19, 1950).

537.591.8

8854. Nuclear disintegration produced by nucleonic radiation at 3 500 m above sea level. J. BUSCHMANN, I. F. QUERCIA AND B. RISPOLI. *Nuovo Cim.*, **7**, 457–69 (*July*, 1950) *In Italian.*

Results obtained with a fast ionization chamber in coincidence with 28 G.M. counters are summarized. If S denotes the number of the ionization bursts per hour in the chamber and K the coincidences per hour between counters and chamber, it is shown that, excluding a small contribution given by extensive air showers, events S are nuclear disintegrations in the chamber and events K are given by: (*a*) stars generated by an ionizing radiation, and (*b*) stars produced by neutral radiation with one or more ionizing penetrating prongs. The ratio N/P between the rates of stars produced by neutral radiation (neutrons) and stars produced by an ionizing radiation (protons and π-mesons) cannot be directly evaluated; however, if it is assumed that the probability of production of prongs of given energy is the same for stars produced by neutrons or protons it is found that $N/P = [1-(K/S)_{Pb}]/[(K/S)_{Pb}-x]$ where $(K/S)_{Pb}$ is the ratio between coincidences and ionization bursts with 5·7 g/cm² of absorber between the chamber and the counters, and x is the ratio of the number of stars with one or more prongs of range greater tha 5·7 g/cm², to the total number of stars. N/P is the order of 7 ÷ 15 for stars of total energy given 6·5 MeV, and 2 ÷ 8 for 8·1 and 10·8 MeV. T absorption path of stars producing radiation paraffin was found to be 206 ± 40 g/cm².

MAGNETISM 538

538.082 : 621.317.4

8855. A recording torque magnetometer. D. MILLER. *Rev. Sci. Instrum.*, **21**, 605–7 (*July*, 1950).

This instrument produces, automatically, a cur of torque v. angle of orientation for a thin Fe steel disc in a strong magnetic field. A resistan strain gauge converts the torque acting on the di specimen to a small d.c. voltage, which is recorded a "strip-chart" recording potentiometer. The spe men is rotated in synchronism with the translation the chart paper, both being driven by synchrono motors. A torque curve is completed in 6 min.

538.082 : 621.317.4

8856. A recording fluxmeter of high accuracy a sensitivity. P. P. CIOFFI. *Rev. Sci. Instrum.*, 2 624–8 (*July*, 1950).

The fluxmeter employs 1 or 2 integrators and double-element L and N Speedomax recorder f tracing magnetization curves directly on standard c ordinate paper. The response of the recorder p drive mechanism is proportional to the flux densi B, and is controlled by the B integrator. The respon of the paper drive mechanism is proportional to t magnetizing force, H, and is controlled either by t magnetizing current, when the specimen is in the for of a ring, or by the H integrator when the specimen in the form of a bar. Ayrton shunt networks provi flexible B and H scale adjustments. High accura and sensitivity are obtained by minimizing the caus of drift. At maximum sensitivity, 4 interlinkag give a deflection of 1 mm.

538.082.1

8857. Magnetochemistry of the heaviest elemen I. A sensitive magnetic susceptibility balance for sm samples. J. K. DAWSON AND M. W. LISTER. *Chem. Soc.*, 2177–81 (*Aug.*, 1950).

A balance is described by means of which magne susceptibilities may be measured on milligra amounts of solids by using a modification of t Faraday method. With a maximum field strength about 2 500 gauss, the susceptibility of a 10 m sample of specific susceptibility 1×10^{-6} is measurab to 0·5%. The balance is convenient for gene susceptibility measurements even when larger amou are available.

538.082.74 : 621.317.4

8858. A permeameter for magnetic testing at ma netizing forces up to 300 oersteds. R. L. SANFOR AND P. H. WINTER. *J. Res. Nat. Bur. Stand Wash.*, **45**, 17–21 (*July*, 1950).

The instrument requires only a single specimen a is simple and rapid to operate. It is an absol

instrument, in that its constants are derived from its own dimensions so that it does not require calibration by any other permeameter. It is estimated that the values of magnetizing force and induction obtained are accurate within 1%, except that for very low values of magnetizing force the uncertainty may be of the order of 0·05 oersted. A.

538.114

8859. Statistical determination of the Curie point of ferromagnetic crystal lattices. V. Zehler. *Z. Naturforsch.*, **5a**, 344–5 (*June*, 1950) *In German.*

Corrects the work of Opechowski [*Physica*, **4**, 181 (1937); **6**, 1112 (1938)]. It is found that the values of the Curie temperature, T_c, of the f.c.c. lattice in the 1st . . . 4th approximation are given by $kT_c/J = 6·0$, 4·73, 4·26, 4·25 respectively, J being the exchange integral. Opechowski was unable to obtain a 4th approximation to T_c and hence suspected the method to diverge. In the case of the simple cubic lattice, the author obtains for T_c in the 4th approximation $kT_c/J = 1·93$, agreeing closely with Weiss's value 1·85 [Abstr. 1093 (1949)].

E. P. WOHLFARTH

538.22

8860. Magnetic properties of some tungsten bronzes. P. M. Stubbin and D. P. Mellor. *J. Proc. Roy. Soc., N.S.W.*, **82** (*Pt.* 3) 225–8 (1948).

These substances have the general formula R_xWO_3, where R is an alkali metal and $0 \leqslant x \leqslant 1$. The susceptibility was measured using the Gouy method over the temperature range 292–485°K, and after correcting for diamagnetism χ_P was found to be small and roughly temperature-independent over this range. This result is consistent with the view that the bronzes contain quasi-metallic partially free electrons exhibiting Pauli spin paramagnetism.

E. P. WOHLFARTH

538.22 : 536.41

Ferromagnetic anomaly in the thermal expansion of ferrites. *See Abstr.* 8696

538.221

8861. On the determination of the complex permeability of ferromagnetic conductors at high frequencies. A. Wieberdink. *Appl. Sci. Res.*, **B1** (*No.* 6) 439–52 (1950).

A method is discussed by which the complex propagation constant of electromagnetic waves in a concentric Lecher system can be determined without the use of calibrated high frequency measuring instruments. When employing a ferromagnetic material as inner conductor, the propagation constant will depend on the permeability, and both the real and imaginary parts of this quantity can be computed, once the propagation constant is known. Results of measurements are given in the case of an alloy of Fe and Ni for which a resonance effect occurs near a wavelength of about 95 cm. A.

538.221

8862. Magnetic properties of ferrites. C. Guillaud. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 12) 113–22 (1950) *In French.*

A comprehensive summary is given of the results of magnetic measurements carried out by the author and his collaborators on simple and mixed ferrites. The variation with the concentration of MO (M = Mn, Co, Ni, Mg) of the absolute saturation moment and the ferromagnetic Curie point in mixed M–Zn ferrites is presented in tabular and graphical form. The results are discussed on the basis of theoretical considerations due to Néel.

E. P. WOHLFARTH

538.221 : 539.26

8863. Structure of ferromagnetic sheets as afforded by electrolytic polishing with alternating currents and by X-ray diagrams. J. Wyart and I. Epelboïn. *Rev. Métall.*, **47**, 511–14 (*July*, 1950) *In French.*

Three methods are described for elucidating the structure of ferro-nickel sheets, viz. (1) that of electrolytic polishing (with respect to uniform distribution of c.d., appropriate bath, and regulated polish); (2) a magnetic study with diagrams showing different permeability distributions throughout the metal; and (3) a radiocrystallographic analysis. It is found that variations of magnetic and crystallographic properties for rolled sheet ferro-nickel of composition $FeNi_3$, exhibit a structural heterogeneity related to the degree of lamination, indicating an atom rearrangement produced by the rolling process resembling that by thermal treatment. Industrial applications are discussed. H. H. HODGSON

538.221 : 548.0 : 537.226.2

Properties of single crystals of nickel ferrite. *See Abstr.* 8728

538.222

8864. Problem of the dispersion of the magnetic permeability of paramagnetics in perpendicular fields for frequencies 10^8 c/s. I. M. Romanov. Letter in *J. Exp. Theor. Phys., USSR*, **20**, 572 (*June*, 1950) *In Russian.*

Supplements Altschuler, Zavoiskii and Kozyrev's determination of the imaginary part of the dynamic permeability [*J. Exp. Theor. Phys., USSR*, **17**, 1122 (1947)] by the corresponding real part based on Kramer's theorem and the formula of the above authors. Paramagnetic salts of the 1st, 6th and 7th group exhibit a permeability corresponding to the formula presented. B. F. KRAUS

538.222

8865. Paramagnetic resonance and hyperfine structure in the iron transition group. A. Abragam. Letter in *Phys. Rev.*, **79**, 534 (*Aug.* 1, 1950).

538.222 : 539.152

8866. Double jumps in paramagnetic resonance. J. Ubbink, J. A. Poulis and C. J. Gorter. Letter in *Physica*, **16**, 570 (*June*, 1950).

The effect is manifested by the appearance of a weak anomalous absorption band. Possible causes for the phenomenon are given; experiments on mixed Fe and Al alums indicate that it is due to interaction between the ions and the inhomogeneous electric field of their surroundings, leading to a failure of the usual selection rules. E. P. WOHLFARTH

[538.222+538.224] : 539.219.1

8867. Notes on the influence of gas on the magnetic properties of para- and diamagnetic metals. H.-J. Seeman. *Rev. Métall.*, **47**, 485–6 (*July*, 1950) *In French.*

Suggests that previously reported results on the

influence of annealing in vacuum on the susceptibility of certain alloys are due, not to removal of gas as was supposed, but to the effect of impurities in the specimens. A. E. DE BARR

538.222 : 541.67

8868. Magnetochemistry of the heaviest elements. II. The oxides of uranium. J. K. DAWSON AND M. W. LISTER. *J. Chem. Soc.*, 2181–7 (*Aug.*, 1950).

Measurements have been made of the magnetic susceptibilities of UO_2 and intermediate oxides up to U_3O_8 over the approximate temperature range 90–570°K, and the results have been correlated with tensimetric and X-ray studies of this sytem. Oxides between UO_2 and $UO_{2\cdot3}$ follow the Weiss–Curie law with high values of Δ, and the susceptibilities are consistent with the view that these oxides contain quadri- and hexavalent, but no quinquevalent, uranium. The magnetic moment of UO_2 has a value corresponding to a $5f^2$ (or $5f^1 \cdot 6d^1$) rather than a $6d^2$ electronic configuration. Above $UO_{2\cdot3}$ there is a two-phase region; reproducible oxides in this middle region are difficult to obtain and give susceptibilities which do not follow the Weiss–Curie law. The exact upper limit of the two-phase region was not defined. It is necessary to express the susceptibility-temperature behaviour of U_3O_8 in the form $(\chi - k)(T + \Delta) = C$. U_3O_8 has a magnetic moment much below that predicted for $UO_2{,}2UO_3$; the moment agrees more nearly with that of $U_2O_5{,}UO_3$, but this requires a rather low value for quinquevalent uranium. The susceptibility of UO has been measured in UO–UO_2 mixtures. A.

538.222 : 548.0

8869. The paramagnetism of color centers in KCl. A. B. SCOTT, H. J. HROSTOWSKI AND L. P. BUPP. *Phys. Rev.*, **79**, 346–9 (*July* 15, 1950).

Two methods for studying susceptibility changes occurring during thermal and optical alterations in colour centres in KCl are described. The magnetic changes accompanying formation of *F'*-centres from *F*-centres, and upon completely destroying both *F*- and *F'*-centres, indicate that the moment of a *F*-centre is that calculated for an *s*-electron, that *F'*-centres have a variable moment depending on the distribution of centres, but generally very nearly that of *F*-centres, and that irradiation during *F'*-centre formation results in a destruction of paramagnetism. A.

538.23

8870. Hysteresis in rotating magnetic fields. T. A. ELKINA. *J. Exp. Theor. Phys., USSR*, **20**, 84–90 (*Jan.*, 1950) *In Russian.*

Calculations are made of the hysteresis losses of rotation in the region of Raleigh magnetic fields for uniaxial ferromagnetic materials. A connection is established between the losses on rotation and on overmagnetization. A comparison is made between the calculation and experiment.

BROOKHAVEN GUIDE TO RUSSIAN LITERATURE

538.245

8871. The results of some researches in ferromagnetism in the light of the modern theory of domains. A. DRIGO. *Tecn. Ital.*, **5**, 151–8 (*May–June*, 1950) *In Italian.*

Collects together and reviews evidence obtained earlier [Abstr. 260 (1949) and 1873 (1950)] with thin electrolytically deposited films of Fe, Ni and Co showing that Barkhausen noise and Bitter patterns disappear for film thicknesses below the theoretical domain wall thickness, while remanence and coercive force pass through maxima. A distinction is made between the coercive forces associated with the total and with the irreversible magnetizations, only the latter being correlated with Barkhausen effects.

F. F. ROBERTS

538.24

8872. The mechanism of colloid agglomeration in the formation of Bitter patterns. C. D. MEE. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 922 (*Aug.*, 1950).

An explanation is given of the findings of Bates and Neale [Abstr. 5152 (1950)], in investigations of powder patterns on Fe–Si single crystals, that the spacing of the deposits is twice the domain width. Experiments with a hexagonal Co crystal are described and the results interpreted. E. P. WOHLFARTH

ELECTROMAGNETISM . ELECTRODYNAMICS

538.3/.5

538.3

8873. On the calculation of the electromagnetic field of moving bodies. T. SCHLOMKA. *Ann. Phys., Lpz.*, **7** (*No.* 5), 228–39 (1950) *In German.*

Continuing previous work [Abstr. 5157 (1950)] various methods of calculating the field are discussed and expressions are given for potentials and intensities for an observer relative to whom the body is in motion. R. A. NEWING

538.3

8874. The hydromagnetic equations. W. M. ELSASSER. Letter in *Phys. Rev.*, **79**, 183 (*July* 1, 1950).

By a change of variables, the author transforms the hydrodynamic equations of motion of an electrically conducting fluid and the electromagnetic field equations into a pair of equations symmetrical in the new variables and analogous to the Stokes–Navier equations. He argues further that this similarity implies the existence of phenomena of turbulence in hydromagnetic systems analogous to those occurring in hydrodynamic systems at mechanical or "magnetic" Reynolds numbers of comparable magnitude.

V. C. A. FERRARO

538.3 : 532.5

8875. Four electromagnetic propositions, with fluid mapper verification. A. D. MOORE. *Elect. Engng., N.Y.*, **67**, 607–10 (*July*, 1950).

The fluid mapper technique [see Abstr. 76 (1950)] is used to verify certain propositions relating to 2-dimensional fields in which Fe specimens of any shape but infinite permeability are variously disposed relative to conductors carrying currents. It is shown that any array of Fe disposed in an array of parallel conductors carrying current may be replaced by enclosing current sheets which are parallel to the main current and that current may be distributed symmetrically in any manner about the axis of a circular conductor without affecting the external field. H. J. H. STARKS

538.3 : 537.11 : 621.3.01

8876. Some unpublished notes of Oliver Heaviside. H. J. JOSEPHS. *The Heaviside Centenary Volume. London, The Institution of Electrical Engineers* (1950) 18–52.—For abstract see Abstr. 5800 (1950).

538.311 : 621.318.4.013.2

8877. A note on the improvement of the field of a solenoid by end coils. B. LEWIS. *Brit. J. Appl. Phys.*, **1**, 238–9 (*Sept.*, 1950).

The addition of end coils to a solenoid considerably improves the uniformity of the axial field. Design procedure is given for the general case, and details of the dimensions and performance of a solenoid constructed to a given specification are quoted. A.

538.521.2 : 621.3.011.1

8878. The two laws of induction in differential form and their application to unipolar induction. A. VON BRUNN. *Bull. Ass. Suisse Elect.*, **41**, 553–69 (*July* 22, 1950) *In German.*

Reviews the flux-linking and flux-cutting laws of e.m.f. induction and shows that the e.m.f. is given by the line integral of the electric field strength, which can be accurately determined from the two laws. Applications to various cases, including the homopolar generator, are given. E. O. TAYLOR (R)

538.565 : 535.223 : 621.396.611.4

8879. Effect of the deformation of a cylindrical cavity resonator on the wavelength of the E_{010} and E_{011} modes. R. MÜLLER. *Z. Naturforsch.*, **5a**, 332–4 (*June*, 1950) *In German.*

The effect is discussed mainly in connection with Essen and Gordon-Smith's measurements of the velocity of light [see Abstr. 2887 (1948)]. It vanishes for the E_{010}-mode, and therefore results obtained by using this mode are more accurate. L. PINCHERLE

538.566

8880. Electro-magneto-ionic waves. V. A. BAILEY AND K. LANDECKER. *Nature, Lond.*, **166**, 259–61 (*Aug.* 12, 1950).

The theory of e.m. waves in an ionized medium subjected to stationary electric and magnetic fields leads to the prediction of several frequency bands in which waves can grow with development of strong e.m. noise for small random perturbations. The authors describe experiments made to test the theory using mostly cylindrical glass discharge tubes with a plain hot cathode or an electron gun and filled with gases such as H, He, N or A at pressures of 0·03 to 0·003 mm Hg. Hg vapour at room temperature was also used. On applying a longitudinal magnetic field exceeding 100 gauss two of three predicted separate noise bands always appeared. The third appeared with He or Hg vapour. V. C. A. FERRARO

538.566 : 535.42 : 621.396.11

8881. Diffraction of a spherical electromagnetic wave on a thin conical surface of finite dimensions. R. G. MIRIMANOV. *Dokl. Akad. Nauk, SSSR*, 73 (*No.* 4) 693–6 (1950) *In Russian.*

538.566 : 621.392

8882. An appreciation of Heaviside's contribution to electromagnetic theory. W. JACKSON. *The Heaviside Centenary Volume. London, The Institution of Electrical Engineers* (1950) 53–69.

For abstract see Abstr. 5969 (1950).

538.566 : 621.392.26

8883. The effect of a screen on the field of an incident electromagnetic wave in a waveguide. E. RUCH. *Ann. Phys., Lpz.*, 7 (*No.* 5) 248–72 (1950) *In German.*

The field is expressed as a sum of the natural oscillations of the tube and must satisfy certain boundary conditions on the plane screen. This leads to a system of infinite equations for the infinite number of coefficients of the series. The problem of the solution of such a system is discussed in general. Approximate numerical calculations are carried out for a screen covering half the cross-section of a rectangular guide, in the case of an *H*-wave.

L. PINCHERLE

538.566 : 621.392.26 : 621.396.67

8884. On the theory of electromagnetic radiation inside metal tubes. R. HONERJÄGER. *Z. Phys.*, **128** (*No.* 1) 72–8 (1950) *In German.*

The total radiation of an electric or magnetic dipole in an infinitely long waveguide of arbitrary cross-section is calculated by expressing the field as the sum of the fields corresponding to the various natural frequencies of the tube. The radiation resistance of the dipole may vary between 0 and ∞ according to the frequency and the cross-section. L. PINCHERLE

538.566 : 621.396.11

8885. The radiation of a magnetic dipole in a stratified medium with spherical symmetry. G. ECKART. *Ann. Télécommun.*, **5**, 173–8 (*May*, 1950) *In French.*

The permittivity is taken to have the form $\varepsilon = a + b/r$ (a, b constants). The solution of the equation for the Fitzgerald potential is obtained both by means of a Green function and by an expansion in spherical harmonics, the coefficients (functions of r) being a generalization of the Bessel functions of half-integral order which apply for a homogeneous medium. L. PINCHERLE

538.566 : 621.396.11

8886. The propagation of very short electric waves. A. GRÜN. *Z. angew. Phys.*, **2** (*No.* 7) 294–301 (1950) *In German.*

Discusses the factors on which the propagation of dm- and cm-waves depend. The author summarizes the standard methods of calculating field strength in the absence of anomalous propagation and atmospheric absorption. Curves are given of the necessary mathematical functions. J. M. HOUGH

538.566 : 621.396.671.029.6

8887. The slot radiator, a magnetic dipole for centimetre waves. H. SEVERIN. *Z. Phys.*, **128** (*No.* 1) 108–19 (1950) *In German.*

The usual slot aerial for the reflection of cm-waves is a magnetic dipole. Its method of operation is indicated using the theory of bending of e.m. waves on a small opening in a perfectly conducting screen. The results, which are a special case of Babinet's

principle in electrodynamics, are discussed mathematically. The theoretical calculations and the corresponding measurements agree well provided the linear dimensions of the opening are $< \lambda/3$.

Z. F. WOJNAR

538.566.2 : 537.523

8888. The scattering of 3-cm radiation from ionized gases. S. N. DENNO, H. A. PRIME AND J. D. CRAGGS. Letter in *Proc. Phys. Soc., Lond. B*, **63**, 726–7 (*Sept.*, 1950).

A preliminary report on measurements of radiation scattered at 90° by discharges in commercial Hg lamp tubes. An electron density figure of $10^{12}/cm^3$ was indicated.

538.566.3 : 551.594.6 : 621.396.11

8889. Experimental determination of the resonance curve of the gyrointeraction phenomenon. M. CUTOLO, R. FERRERO AND M. MOTZO. *Alta Frequenza*, **19**, 3–8 (*Feb.*, 1950) *In Italian.*

Bailey's theory predicts splitting of the resonance curve when the received wave penetrates > 4 km into the E layer. The theory is confirmed by measurements of the parasitic modulation appearing on signals received at Turin from transmitters in Southern Italy and Sicily, due to a perturbing transmitter of adjustable frequency at Florence. The parasitic modulation depth reached 9% at the peaks at $\lambda = 232$ m and 274 m and fell to a minimum of $\sim 0{\cdot}5\%$ at an intermediate λ. F. F. ROBERTS (R)

538.566.3 : 551.594.6 : 621.396.11

8890. Effects of radio gyrointeraction and their interpretation. M. CUTOLO. *Nature, Lond.*, **166**, 98–100 (*July* 15, 1950).

Description of ionospheric cross-modulation experiments in which the frequency of the disturbing wave was varied over a range about the gyro frequency. The results agree with the theory of Bailey [*Phil. Mag.*, **23**, 929 (1937); **26**, 425 (1938)] in that the depth of the transferred modulation shows two maxima, one on each side of the gyro frequency. At the gyro frequency the cross-modulation depth was in general $< 0{\cdot}5\%$. W. J. G. BEYNON (R)

538.567

8891. Reflection and transmission of electromagnetic waves by thin curved shells. J. B. KELLER. *J. Appl. Phys.*, **21**, 896–901 (*Sept.*, 1950).

The scattering of an arbitrary electromagnetic field by a conducting or non-conducting obstacle is investigated. The differential equations and boundary conditions satisfied by the field are transformed into a pair of inhomogeneous linear integro-differential equations for E and H. For an obstacle which is a thin shell of constant thickness h, a formal procedure for obtaining a solution of these equations as power series in h is given. The lowest order term in this solution is the incident field. An explicit expression for the next term is found in the form of a surface integral. This integral is evaluated approximately by the method of stationary phase. The physical properties of the solution are examined in detail, and satisfactory agreement is found with many results previously obtained by other methods. A.

MAGNETIC EFFECTS 538.6

538.652

8892. Magnetostriction of ferromagnetic alloys in the region of the paraprocess. K. P. BELOV. *J. Exp. Theor. Phys., USSR*, **20**, 54–61 (*Jan.*, 1950) *In Russian.*

The results of measurements of the transverse and longitudinal effects of magnetostriction of alloys are presented for the invar group for magnetic fields higher than the "technical" saturation region (region of the paraprocess). The unusually high magnetostriction observed in those alloys compared to others alloys is due, not so much to the low Curie point in these alloys, but to peculiarities in their structure which bring about a rather sharp dependence of the volume integral on the lattice parameter.

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538.652

8893. New magnetostriction alloys Fe–Pd and Ni–Pd. Z. I. ALIZADE. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 1) 79–81 (1950) *In Russian.*

538.652

8894. A new method of measuring magnetostriction. Application to Co ferrite. L. WEIL, M. GALLAY AND P. POENSIN. *C.R. Acad. Sci., Paris*, **231**, 224–6 (*July* 17, 1950) *In French.*

Describes the use of resistance strain gauges for the measurement of magnetostriction and gives preliminary results for a disc specimen of Co ferrite.

A. E. DE BARR

538.652

8895. The magnetostriction of permanent magnet alloys. E. A. NESBITT. *J. Appl. Phys.*, **21**, 879–89 (*Sept.*, 1950).

Magnetostriction measurements have been made on various alloys having coercive forces from 50 to 600 oersteds. The results can be summarized by discussing two types of alloys. For the older carbon-hardening permanent magnets high coercive force and high magnetostriction occur together. For the newer carbon-free permanent magnets high coercive force does not occur with high magnetostriction. In fact, for the Mishima alloys having compositions near 29% Ni, 12·5% Al and 58·5% Fe, cooled at the rate of 3°c per second (coercive force 400 oersteds), the magnetostriction actually passes through zero. This is contrary to the classical strain theory of coercive force and to explain this it is necessary to resort to more recent theories. A.

THEORY OF SOLID STATE 539.11

539.11

8896. The effect of electron concentration on the lattice spacings in magnesium solid solutions. H. JONES. *Phil. Mag.*, **41**, 663–70 (*July*, 1950).

The hypothesis that the change in the c/a ratio in Mg solid solutions is due to the changes in the Fermi energy, arising from the distortion of the Brillouin zone, is developed into a more general and quanti-

tative theory. The case of monovalent solutes is considered, and agreement with experiment is shown to be not unsatisfactory. The experimental results enable deductions to be made regarding the density of electronic states in pure Mg. A.

539.11

8897. An application of the W.K.B. method to the cohesive energy of monovalent metals. T. S. KUHN. *Phys. Rev.*, **79**, 515–19 (*Aug.* 1, 1950).

A new method is developed which, within the limits of the spherical cell approximation first presented by Wigner and Seitz, will permit the evaluation of the cohesive energy, lattice constant, and compressibility of a monovalent metallic solid without the explicit computation of a central field for the atom. Analytic formulae for approximate solid state wave functions are produced in the region outside the atomic core by utilizing Imai's form of the W.K.B. method with the phase constant determined explicitly in terms of the known quantum defect of the free atom. These wave functions are applied to the determination of the minimum ground state energy in the alkali metals and of the sphere radius at which this occurs as functions of the quantum defects of the free atoms. These functions, when applied to Fröhlich's semi-empirical formula, yield a rapid and accurate method for the computation of the ground-state energy as a function of sphere radius. A.

MOLECULAR STRUCTURE 539.13

539.13 : 535.375.5

Structure determination of molecules with the aid of the Raman effect. *See Abstr.* 8645

539.132

8898. Molecular orbitals for H_3^+. J. M. WALSH, R. A. MOORE AND F. A. MATSEN. *J. Chem. Phys.*, **18**, 1070–2 (*Aug.*, 1950).

A somewhat more general concept of molecular orbitals than used heretofore is applied to H_3^+. It is shown to be superior to the Heitler–London approximation, but inferior to the HLSP-plus-ionic-terms treatment of Hirschfelder. Relations between the HLSP and molecular orbital approaches to wave functions are discussed. A.

539.132 : 539.152.1

8899. The nuclear quadrupole moment of N^{14} and the structure of nitrogen trifluoride from microwave spectra. J. SHERIDAN AND W. GORDY. *Phys. Rev.*, **79**, 513–15 (*Aug.* 1, 1950).

Measurements of the $J = 1 \rightarrow 2$ rotational transitions of $N^{14}F_3$ and $N^{15}F_3$ yield the following molecular and nuclear properties. For $N^{14}F_3$, $B_0 = 10\,680{\cdot}96$ Mc/s, $I_B = 78{\cdot}5475 \times 10^{-40}$ g cm^2; for $N^{15}F_3$, $B_0 = 10\,629{\cdot}35$ Mc/s, $I_B = 78{\cdot}9291 \times 10^{-40}$ g cm^2. The molecular dimensions are: $d_{NF} = 1{\cdot}371$ Å and $\angle FNF = 102° 9'$. The nuclear quadrupole coupling of N^{14} is $-7{\cdot}07$ Mc/s. This yields $+0{\cdot}01 \times 10^{-24}$ cm^2 as the most probable value of the nuclear quadrupole moment of N^{14}. A.

539.132 : 541.57

8900. Bond energy and bond order. G. NEBBIA. Letter in *J. Chem. Phys.*, **18**, 1116–17 (*Aug.*, 1950).

Assuming that the dissociation energy is the sum of bond energies, curves of bond length *v.* bond energy are given for C–C, C–O and C–N bonds.

G. J. KYNCH

539.133

8901. Thermodynamic properties of the internal rotation in methyl alcohol vapor from 200 to 500°K. J. O. HALFORD. *J. Chem. Phys.*, **18**, 1051–6 (*Aug.*, 1950).

For any internal rotator, of a given symmetry, with a fixed moment of inertia and potential barrier, two limiting values of each property can be calculated for any chosen temperature. Available tables are restricted to those cases for which the differences between the limiting values can be neglected. When, as with methyl alcohol, the differences are large, the representative values can be found by taking proper account of the symmetry and the dependence of the internal rotator energy levels upon the external rotations. For methyl alcohol, the correct intermediate thermodynamic properties are obtained by using for the partition function and its derivatives the numerical mean of the limiting values of these sums obtained for the general rotator. This simple rule, however, is not necessarily applicable to other compounds. Heat capacities and entropies, calculated from the spectroscopic potential barrier of 932 cal/mole and other molecular constants, are considered in relation to experimental data. A.

539.133

8902. The quadrupole coupling of three nuclei in a rotating molecule. R. BERSOHN. Letter in *J. Chem. Phys.*, **18**, 1124–5 (*Aug.*, 1950).

539.133

8903. The Franck–Condon principle and the size of the excited benzene molecule. D. P. CRAIG. *J. Chem. Soc.*, 2146–51 (*Aug.*, 1950).

The Franck–Condon principle applied to the experimental intensity distribution in the 2 600 Å band system of benzene gives the value 0·037 Å for the increase in equilibrium C–C distance in the excited electronic state. This agrees well with values deduced from empirical relations between force constant and bond length. The calculation of changes in molecular dimensions by means of the Franck–Condon principle may be carried out in various simplified ways; two of these are examined. The assumption that CH groups are concentrated in mass points gives the value 0·036 Å. If, in addition, it is assumed that the force constants are unchanged in the excited state, a value 0·035–0·036 Å is obtained. The last calculation demands no detailed information about the excited electronic state, and so may be applied to study changes in dimensions of more complicated molecules whose excited-state elastic constants are not known. A.

539.133 : 535.343–14

The radiofrequency spectrum of $Rb^{85}F$ and $Rb^{87}F$ by the electric resonance method. *See Abstr.* 8631

539.133 : 538.222

8904. Orbital and spin contributions to paramagnetism of hexavalent chromium compounds. D. S. DATAR. Letter in *J. Chem. Phys.*, **18**, 1120 (*Aug.*, 1950).

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15

8905. Atomic physics. W. FINKELNBURG. *New York, Toronto, London. McGraw-Hill Book Co.* (1950) 498 *pp.*, 226 *figs.*

A translation from the German brought up to date as at spring, 1949. Intended for graduate students and research workers, the book stresses the meaning of experiments and theories, and the inter-relations between such seemingly divergent fields as atomic, molecular, nuclear and solid-state physics, rather than mathematical or experimental details. Chapter headings: Atoms, ions, electrons, atomic nuclei, photons; Atomic spectra and atomic structure; The atomic theory according to quantum mechanics; Nuclear physics; Molecular physics; Atomic physics of the liquid and solid state.

539.152

8906. Asymptotic expression for the stopping power of *K*-electrons. L. M. BROWN. *Phys. Rev.*, **79**, 297–303 (*July* 15, 1950).

An asymptotic form for the high-energy stopping number of *K*-electrons (for any element) is determined by using the Born approximation expressions for the excitation and ionization probabilities of the *K* shell. The stopping number takes the form $B_K(\theta, \eta) = A(\theta) \ln \eta + B(\theta) + C(\theta)(1/\eta) + \ldots$, where η is a dimensionless quantity proportional to the energy of the incident particle and θ is proportional to the observed ionization energy of the *K* shell. Other results include the stopping number for H, obtained by sum-rule methods, to order $(1/\eta)$, and results of M. C. Walske, obtained by numerical methods, for the low-energy stopping number of *K*-electrons. A.

539.152

8907. Stopping power of *K*-electrons. H. A. BETHE, L. M. BROWN AND W. C. WALSKE. Letter in *Phys. Rev.*, **79**, 413 (*July* 15, 1950).

A correction is derived, regarding the interpretation of the coefficient of the logarithmic term, of the formula for the contribution of *K*-electrons to the stopping number [Livingston and Bethe, *Rev. Mod. Phys.*, **9**, 264 (1937)]. W. J. SWIATECKI

539.152.1

8908. Nuclear dipole oscillations and resonances at high γ-energies. J. H. D. JENSEN AND P. JENSEN. *Z. Naturforsch.*, **5a**, 343–4 (*June*, 1950) *In German.*

The γ-ray nuclear absorption resonance energy is calculated assuming it corresponds to the eigen-frequency in a model in which the protons oscillate as a liquid in a "neutron liquid." Better agreement with experiment for the dependence of this resonance energy on the mass number of the nucleus is obtained than in the case of the Goldhaber–Teller "reststrahl" model [Abstr. 659 (1949)]. J. HUGHES

539.152

8909. On the shift of the nuclear magnetic resonance in paramagnetic solutions. N. BLOEMBERGEN AND W. C. DICKINSON. Letter in *Phys. Rev.*, **79**, 179–80 (*July* 1, 1950).

If paramagnetic ions are added to the liquid sample under investigation the effective field at the nucleus is changed (apart from shape effects) by an amount qM. The factor q depends on the chemical compound used in the liquid sample and may be positive or negative. A tentative interpretation of this effect is given, and a relation for q deduced, involving the anisotropy factor $g_{\parallel}^2 - g_{\perp}^2$. E. P. WOHLFARTH

539.152

8910. A 1·0-Mev energy level in C^{13}. I. B. BERLMAN. Letter in *Phys. Rev.*, **79**, 411 (*July* 15, 1950).

539.152

8911. Nuclear energy level argument for a spheroidal nuclear model. J. RAINWATER. *Phys. Rev.*, **79**, 432–4 (*Aug.* 1, 1950).

Recently there has been notable success in explaining many nuclear phenomena on the basis of a single particle model for the separate nucleons in a spherical nucleus. The spherical model, however, seems incapable of explaining the observed large quadrupole moments of nuclei. In this paper it is shown that an extension of the logic of this model leads to the prediction that greater stability is obtained for a spheroidal than for a spherical nucleus of the same volume, when reasonable assumptions are made concerning the variation of the energy terms on distortion. The predicted quadrupole moment variation with odd A is in general agreement with the experimental values as concerns variation with A but are even larger than the experimental values. Since the true situation probably involves considerable "dilution" of the extreme single particle model, it is encouraging that the present predictions are larger rather than smaller than the experimental results. A solution is given for the energy levels of a particle in a spheroidal box. A.

539.152.1 : 539.165

8912. On the nuclei of mass number 10. R. BOUCHEZ AND R. NATAF. *J. Phys. Radium*, **11**, 266–70 (*June*, 1950) *In French.*

The beta emissions of Be^{10} and C^{10} are studied by means of the new selection rules on ΔJ and ΔL which were proposed by R. Bouchez [*C.R. Acad. Sci. Paris*, **230**, 440 (*Jan.* 30, 1950)] and R. Nataf [see Abstr. 5229 (1950)] on a quasi-atomic model of the nucleus. Evidence for the following scheme is found:

$$Be^{10} \rightarrow B^{10} \begin{cases} {}^1S_0 - \beta^- \rightarrow {}^3D_3 \\ {}^1S_0 - \beta^- \rightarrow {}^1D_2 - \gamma \rightarrow {}^3D_3; \end{cases}$$

$$C^{10} \rightarrow B^{10},\ {}^1S_0 - \beta^+ \rightarrow {}^3S_2 - \gamma \rightarrow {}^3D_3.$$

It is shown further that the binding between pairs of nucleons in the $2p$ shell of Be^{10} and C^{10} obeys the following relations: $(p\uparrow p\uparrow) \approx (n\uparrow n\uparrow)$ (Kemmer's rule) and $(p\uparrow n\uparrow) - (n\uparrow n\downarrow) \approx 2$ MeV. W. J. SWIATECKI

539.152.2

8913. The nuclear magnetic moment of scandium^{45}. R. E. SHERIFF AND D. WILLIAMS. Letter in *Phys. Rev.*, **79**, 175 (*July* 1, 1950).

539.152.2

8914. Nuclear magnetic resonance in metallic hydrides. M. A. GARSTENS. Letter in *Phys. Rev.*, **79**, 397–8 (*July* 15, 1950).

539.152.2

8915. The electrical quadrupole moments of atomic nuclei. F. FILIPPAZZI. *Nuovo Cim.*, **7** (*Suppl. No.* 1) 12–53 (1950) *In Italian.*

The general definition of electrical four-pole moment for any distribution of electricity is given, showing that the moment q can characterize the form of the distribution. The existence of electrical moments $q >, =$ or < 0 in the atomic nuclei is discussed after a consideration of the other moments—mechanical and magnetic—of the nuclei. An explanation of how and which spectroscopical anomalies originally suggested the idea of the existence in the nuclei of electrical four-pole moments $q \neq 0$ is given, and these ideas are quantitatively developed. Starting from the quantum definition of the four-pole moments of the nucleus and of the electronic cloud, the electrostatic interaction energy between nucleus and electrons is calculated, supposing the nucleus not necessarily spherical. The results of the theory are in agreement with the spectroscopical evidence and furnish, therefore, a convincing indirect proof of the existence of nuclear moments $q >, =$ or < 0. A short account is given of the methods for the experimental determination of the nuclear four-poles (optical spectroscopy, microwave spectroscopy, magnetic resonance), and a table of experimental results so far obtained. A.

539.152.2 : 545.8

8916. Nuclear magnetic resonance absorption in hygroscopic materials. T. M. SHAW AND R. L. ELSKEN. Letter in *J. Chem. Phys.*, **18**, 1113–14 (*Aug.*, 1950).

539.153

8917. Examples on the calculation of energy states by the uncertainty relations. H. P. SOH. Letter in *Phil. Mag.*, **41**, 851–4 (*Aug.*, 1950).

The examples considered are: H atom; relativistic H atom; H atom, including the motion of the nucleus; He-like atoms. L. PINCHERLE

539.153 : 538.615

8918. Unequal g-values for the different magnetic levels of an atomic energy level. M. A. CATALÁN AND R. VELASCO. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 917–19 (*Aug.*, 1950).

The Mn spectrum in a magnetic field of 80 000 oersted displays asymmetries which are discussed in terms of the theory of the Paschen–Back effect and g-values are derived. It is found that a level $z^6F_{3/2}$, owing to the influence of an adjacent $z^6F_{1/2}$ level, exhibits two g-values, one for each pair of its magnetic levels. Thus g-values cannot be calculated by using all the lines of the pattern at the same time but by dividing them into two groups and calculating for each group separately. The question is raised of the accuracy of recorded g-values, obtained without regard to the magnetic levels involved. W. R. ANGUS

539.153.4

8919. Effect of nuclear motion on the fine structure of hydrogen. T. ISHIDZU. Letter in *Progr. Theor. Phys.*, **5**, 307 (*March–April*, 1950).

539.153.4

8920. On the quantization of the metric field and the interaction of field-particles. IV. Application to the spectrum of hydrogen. A. GIÃO. *C.R. Acad. Sci., Paris*, **230**, 1838–40 (*May* 22, 1950) *In French.*

Discussion of the hyperfine structure of the H spectrum under the assumption of a non-Coulombian potential suggested in an earlier paper. J. R. MADDOX

539.154

8921. The Bohr formula for the Rydberg constant. R. T. BIRGE. Letter in *Phys. Rev.*, **79**, 193–4 (*July* 1, 1950).

As there is now available a number of high precision results in various fields, each of which involves one or more of the atomic constants, it has become possible to make a direct check of the Bohr formula. A careful study of the assigned uncertainties for the various constants leads to an expression for R_∞, whose numerical value is $109\,731{\cdot}61 \pm 7{\cdot}03\ \mathrm{cm}^{-1}$; the discrepancy with the direct spectroscopic value is $-3{\cdot}69 \pm 7{\cdot}03\ \mathrm{cm}^{-1}$. If the probable errors of all the constants are ignored, except that on the gyromagnetic ratio of the proton γ_P, the probable error in R_∞ is reduced only to $6{\cdot}56\ \mathrm{cm}^{-1}$. Thus this verification of Bohr's formula (accurate to less than one part in 10^4) rests primarily on the assigned accuracy of γ_P, which in turn depends upon the accuracy of the measurement of a certain magnetic field in absolute units. L. PINCHERLE

539.154.3 : 548.7

8922. The influence of ordered structure of nickel-manganese alloys on the atomic magnetic moment and the anisotropy constant. F. M. GALPERIN AND T. M. PEREKALINA. *J. Exp. Theor. Phys., USSR*, **20**, 73–83 (*Jan.*, 1950) *In Russian.*

Experiments were carried out, and then the atomic magnetic moments were calculated for Ni–Mn alloys and for ordered alloys of the stoichiometric composition Ni_3Mn. The calculated quantities and those experimentally determined are in satisfactory agreement. The constant of magnetic anisotropy is investigated as a function of component concentrations and ordering of alloys. It is shown that, for the same system of alloys of Ni–Mn, two completely contrary phenomena are possible. The increase of the constant of magnetic anisotropy with increase in ordering takes place for one set of concentrations while it decreases with the degree of ordering for other concentrations. In the alloy system Ni–Mn, the existence of a hyperstructure for the Ni_3Mn alloy is firmly established. The atomic magnetic moment measured here is not equal to 3 magnetons, as reported by Sandron [*Ann. de Phys.*, **17**, 371 (1932)], but 3·20 magnetons in the annealed state. A calculation of the atomic magnetic moment, using the formula of Galperin [Abstr. 4931 (1949)], gives the value of 3·17. The experimentally determined atomic magnetic moment of an ordered alloy of stoichiometric composition Ni_3Mn is 0·9 to 0·94 magnetons, and the value calculated on the Galperin formula is 0·92 magneton. This shows that the formula proposed satisfactorily represents the situation in the region of interest. The dependence of the atomic magnetic moment and of

the magnetic anisotropy constant on the Mn concentration in the alloys has the same character.
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539.155

8923. Masses of Si^{28}, Si^{29}, Mn^{55}, Fe^{56}, Ni^{58}, Pd^{110}, Cd^{110}, Cd^{112}, Cd^{116}, and Sn^{116}. H. E. DUCKWORTH AND R. S. PRESTON. Letter in *Phys. Rev.*, **79**, 402 (*July* 15, 1950).

539.155.2

8924. U^{235} in thucholite. J. B. ORR. Letter in *Phys. Rev.*, **79**, 401–2 (*July* 15, 1950).

539.155.2

8925. A redetermination of the relative abundances of the isotopes of neon, krypton, rubidium, xenon, and mercury. A. O. NIER. *Phys. Rev.*, **79**, 450–4 (*Aug.* 1, 1950).

The mass spectrometer employed was calibrated for mass discriminative effects with a synthetic argon isotope mixture made from essentially pure samples of A^{36} and A^{40}. The present results, together with those obtained from an earlier study on C, N, O, A and K, enable one to use the several elements investigated as sub-standards for calibrating mass spectrometers for mass discriminative effects in other instances. A.

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16

8926. On the activity of the small crystals with pleochroic haloes contained in a granite. R. COPPENS. *C.R. Acad. Sci. Paris*, **23**, 343–5 (*July* 31, 1950) *In French.*

539.16 : 551.59

8927. Creation of a flying laboratory and perfecting of apparatus for the study of the feeble radioactivity of the atmosphere. H. GARRIGUE. *C.R. Acad. Sci., Paris*, **230**, 2279–80 (*June* 26, 1950) *In French.*

In order to continue work on the presence of radioactivity in the atmosphere [see Abstr. 7215 (1949)] an aeroplane has been equipped as a flying laboratory. Preliminary confirmation has been obtained of a long period activity of unknown origin. G. O. BAINES

539.16.08

8928. Measuring instruments for the protection of personnel against radioactive radiations. J. WEILL. *Onde Elect.*, **30**, 328–34 (*July*, 1950) *In French.*

The tolerance dosis adopted by the U.S.A., the U.K. and France is 0·1 roentgen per 8 hr day. The equivalent for neutrons is 5 000 neutrons/cm²/sec. Radioactive energy is measured by means of photographic emulsions, G.M. counters or ionization chambers. Photographic plates register α-, β-, γ-rays and neutrons. As the last does not directly leave a trace in the emulsion, a thin Cd foil is interposed which, on absorbing the neutrons, emits γ-radiation which causes traces in the photographic emulsion. The plates are then evaluated in a photometer which is empirically graduated in roentgen units. A pencil-type electroscope is discussed. The ionization chamber of the Atomic Energy Commission is shown in detail and formulae for its calculation as well as the wiring diagram are given. W. SUMMER

539.16.0

8929. A photomultiplier apparatus for measuring radium emanation. A. DRIGO. *Nuovo Cim.*, **7**, 501–1 (*July*, 1950) *In Italian.*

Two methods for determining the amount of radon based on the use of scintillation counters, are described. In both cases the measurement is made indirectly as the amount of radon is deduced from the measurement of the activity of solid deposits of Ra A, Ra B and Ra C. There are two different methods of collecting the deposits. For small quantities, from 10^{-14} to 10^{-16} curie/cm³, the method of corona discharge, inside a vessel of 50–100 l capacity, is used. For larger quantities, up to 10^{-9} curie/cm³, it is sufficient to deposit that part of Ra A which is positively charged, on a negative electrode. For still larger quantities it is advisable to reduce with a diaphragm that portion of the electrode which is actually exposed to the fluorescent screen of the counter.

539.16.08 : 621.38

8930. A radiation meter for disaster use. C. C. LAURITSEN AND T. LAURITSEN. *Science*, **112**, 137–4 (*Aug.* 4, 1950).

Specification and design of a simple robust pocket radiation dosemeter, consisting of an electrostatic voltmeter movement in a case acting as an ionization chamber; a friction device is used to charge the electrode. The sensitivity recommended is 0·1 1·0 roentgens for full-scale deflection. A. O. STANESBY

539.16.08 : 778.3

8931. Photographic emulsion method applied to the investigation of radioactive deposits from atmospheric air. R. SIKSNA. *Tellus*, **2**, 89–92 (*May*, 1950).

It is shown that with this simple and convenient method it is possible to obtain many fine details of the phenomenon also in case of quite weak activity. It is also shown that the method can be employed with success in the investigation of the mobility of radioactive carriers in atmospheric air. A.

539.16

8932. On the directional correlation of successive nuclear radiations. D. L. FALKOFF AND G. E. UHLENBECK. *Phys. Rev.*, **79**, 323–33 (*July* 15, 1950).

It is shown that the theoretical specification of angular correlation requires two kinds of information, namely, the angular momenta of the nuclear states and emitted radiations, and the Hamiltonian interaction between the outgoing particles and nucleus. The former information enters in the same way in all angular correlations while the latter, differing with the kind of particles emitted, is needed to obtain the angular distributions associated with each component of a line. The structure of such angular distributions is studied in relation to isotropy requirements and an explicit construction to exhibit them is given. Systematic simplifications in the calculation of angular correlation functions $W(\theta)$ are shown to result from several theorems relating to the combinations of transformation coefficients occurring in $W(\theta)$

These make possible a complete tabulation of $W(\theta)$ in canonical forms applicable, on proper specialization, to any angular correlation in which the angular momentum of the decay products in either transition is 1 or $2\hbar$. The specializations for α- and γ-emission are given. A.

539.162

8933. The $4n + 1$ radioactive series: the decay products of U^{233}. F. HAGEMANN, L. I. KATZIN, M. H. STUDIER, G. T. SEABORG AND A. GHIORSO. *Phys. Rev.*, **79**, 435–43 (*Aug.* 1, 1950).

The path of the artificially produced $4n + 1$ radioactive decay series between U^{233} and Bi^{209} and the properties of the individual members of the chain are developed. A.

539.162.1

8934. Decay constants of K^{40}. G. A. SAWYER AND M. L. WIEDENBECK. *Phys. Rev.*, **79**, 490–4 (*Aug.* 1, 1950).

New measurements have been made of the decay constants of K^{40} for beta-ray emission and for electron capture, and a decay scheme is proposed on the basis of these measurements and the previous data. Special counters adapted to the measurement of low levels of activity were developed for making the measurements. The results obtained were $28{\cdot}3 \pm 1{\cdot}0$ beta-rays per gram of K per sec and $13{\cdot}5 \pm 4{\cdot}0$ electron captures per 100 beta-rays, corresponding to a total half-life of $12{\cdot}7 \pm 0{\cdot}5 \times 10^8$ yr, with 88% of the decays by beta-ray emission and 12% by electron capture. A previous measurement of the gamma-ray intensity in K^{40}, by the present authors, gave $3{\cdot}6 \pm 0{\cdot}3$ gamma-rays per gram of K per sec, or about $12{\cdot}7$ gamma-rays per 100 beta-rays. Since the numbers of gamma-rays and of electron captures in the decay of K^{40} are essentially the same, and since previous measurements indicate that the gamma-energy is greater than the beta-energy, it is proposed that the gamma-ray be associated with the electron-capture decay, a gamma-ray following each electron capture. A.

539.163

8935. Half-life of Pa^{232}. A. H. JAFFEY AND E. K. HYDE. *Phys. Rev.*, **79**, 280–2 (*July* 15, 1950).

The half-life of Pa^{232} from two methods of preparation ($Pa^{231} + n$ and $Th^{232} + d$) has been measured and found to be $1{\cdot}32$ days. A.

539.163

8936. Properties of Tl^{209}. F. HAGEMANN. Letter in *Phys. Rev.*, **79**, 534–5 (*Aug.* 1, 1950).

Tl^{209} is formed in the alpha-decay branch of Bi^{213}. The half-life was determined to be $2{\cdot}20 \pm 0{\cdot}07$ min. The beta-spectrum had a max. energy of $1{\cdot}8$ MeV, the half-thickness being about 80 mg Al/cm^2.

539.163.1

8937. The half-life of strontium^{90}. R. I. POWERS AND A. F. VOIGT. Letter in *Phys. Rev.*, **79**, 175 (*July* 1, 1950).

539.163.1

8938. The half-life of sodium 24. A. K. SOLOMON. Letter in *Phys. Rev.*, **79**, 403 (*July* 15, 1950).

539.163.1

8939. The half-life of the isomeric state in ^{169}Tm. E. W. FULLER. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 1044 (*Sept.*, 1950).

The investigation yielded a value $T_{\frac{1}{2}} = 0{\cdot}658 \pm 0{\cdot}003$ μsec, using the technique of Abstr. 3409 (1949).

539.163.1 : 778.34

8940. A photographic method for determining half-lives. E. RABINOWICZ. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 1040–1 (*Sept.*, 1950).

The method is similar to that of Zuber [Abstr. 4378 (1948)].

539.163.2

8941. Neutron-induced radioactivity in palladium. A. STORRUSTE. Letter in *Phys. Rev.*, **79**, 193 (*July* 1, 1950).

539.163.2

8942. Coincidence studies of the disintegration of Sc^{44}. W. H. CUFFEY. Letter in *Phys. Rev.*, **79**, 180–1 (*July* 1, 1950).

539.163.2

8943. Some characteristics of the 11-day neodymium (147). C. E. MANDEVILLE AND E. SHAPIRO. Letter in *Phys. Rev.*, **79**, 391 (*July* 15, 1950).

539.163.2

8944. The radioactivity of Hf^{181}. M. DEUTSCH AND A. HEDGRAN. Letter in *Phys. Rev.*, **79**, 400–1 (*July* 15, 1950).

539.163.2

8945. Decay of Au^{199}. R. D. HILL. Letter in *Phys. Rev.*, **79**, 413–14 (*July* 15, 1950).

539.163.2

8946. Isomerism in Co^{58}. K. STRAUCH. *Phys. Rev.*, **79**, 487–90 (*Aug.* 1, 1950).

An isomer of Co^{58} has been identified which decays with a half-life of $8{\cdot}8$ hr by emission of a $24{\cdot}9 \pm 1{\cdot}0$ keV γ-ray. The ratio of the K and L conversion coefficients was $1{\cdot}9 \pm 0{\cdot}2$. The relative cross-section for formation of the isomeric and ground state of Co^{58} by alpha-particle bombardment of Mn was found to be $1{\cdot}7$. The conversion coefficient of the 805 keV γ-ray of Fe^{58} was $2{\cdot}5 \times 10^{-4}$. Possible decay schemes are presented. A.

539.164

8947. Short range alpha particles from the break-up of ^8Li. A. S. BAXTER, W. E. BURCHAM AND E. B. PAUL. *Phil. Mag.*, **41**, 937–41 (*Sept.*, 1950).

The energy spectrum of the alpha particles from the Li^8–Be^{8*} break-up has been studied using a magnetic analyser and thin targets. The most probable energy of the alpha-particle pair emitted was found to be $3\,150 \pm 50$ keV. A.

539.164.1

8948. Anomalies in the α-particle range-velocity relation observed in nuclear emulsions. L. VIGNERON AND M. BOGAARDT. *C.R. Acad. Sci., Paris*, **230**, 2176–8 (*June* 19, 1950) *In French.*

Compared with the corresponding proton range-velocity relation in nuclear emulsions, the α-particle range falls off more slowly with velocity in the low-energy region. A. O. STANESBY

539.165

8949. The origin of "positive tracks" observed on Wilson-photos of beta sources. J. H. SPAA, G. STENEKER AND G. J. SIZOO. *Physica*, **16**, 555–69 (*June*, 1950).

The results of new Wilson-chamber experiments as well as the re-examination of the results of previous experiments [Abstr. 6184 (1949)] lead to the conclusion that the "positive tracks" observed on Wilson-photos of beta sources, are not due to positive particles, but to electrons moving backward to the source. The main causes for these return-electrons are the reflection by the walls of the chamber and the movement in circular paths due to the magnetic field. The effect of multiple and single scattering in the chamber gas is calculated and proves to be of secondary importance. For the examination of the photos a special method was developed in which use was made of fictitious source spots, concentric and conform to the real source spot. A.

539.165

8950. On the beta-gamma-angular correlation. D. L. FALKOFF AND G. E. UHLENBECK. *Phys. Rev.*, **79**, 334–40 (*July* 15, 1950).

The angular distributions for the components of a line in a β-transition are exhibited for use in obtaining numerical values for the angular correlation between successive nuclear beta- and gamma-radiations. The calculations are made with each of the 5 linearly independent electron-neutrino interactions (assuming $Z = 0$) for allowed, first and second forbidden β-transitions. In general, the theory yields an angular correlation for forbidden β-transitions which will vary with the interaction and the degree of forbiddenness, and thus affords a means of distinguishing between these. It is shown that no angular correlation is to be expected whenever (*a*) the β-transition is allowed, (*b*) the transition is classified as forbidden but has an allowed energy spectrum, (*c*) only the low energy β-particles are counted. A.

539.165

8951. The beta-spectrum of Sn^{125}. R. W. HAYWARD. Letter in *Phys. Rev.*, **79**, 409 (*July* 15, 1950).

539.165

8952. First-forbidden beta-spectra and the beta-spectrum of Sr^{90}–Y^{90}. L. J. LASLETT, E. N. JENSEN AND A. PASKIN. Letter in *Phys. Rev.*, **79**, 412 (*July* 15, 1950).

539.165

8953. Spectrometer and coincidence studies on Np^{238}. M. S. FREEDMAN, A. H. JAFFEY AND F. WAGNER, JR. Letter in *Phys. Rev.*, **79**, 410–11 (*July* 15, 1950).

539.165

8954. Capture of slow beta electrons at the outer orbits of heavy atoms. D. IVANENKO AND V. LEBEDEV. *J. Exp. Theor. Phys., USSR*, **20**, 91–2 (*Jan.*, 1950) *In Russian.* English translation in *Guide Russ. Sci. Period Lit., Brookhaven*, **3**, 162–3 (*June*, 1950).

A new type of β-decay is suggested in which the β-particle is captured into an unoccupied level of the product nucleus, with emission of a photon. This could reduce the probability of escape of a β-particle by several tenths for very soft spectra of heavy atoms, and account qualitatively for the results obtained on MsTh1 and MsTh2 [Abstr. 1145, 2678 (1949)]. B. ROSE

539.165

8955. Distributed beta sources in uniformly absorbing media. I. H. H. ROSSI AND R. H. ELLIS, JR. *Nucleonics*, **7**, 18–25 (*July*, 1950).

Beta fluxes and energy doses from uniformly distributed sources are calculated on the assumption that absorption occurs exponentially. A number of simple geometric shapes is assumed for the source distributions, including point source, infinite half-space, infinite slab, infinite thin plane and sphere. Calculations are extended over the interior and exterior of the source space, the same absorption coefficient being assumed in both regions. L. R. SHEPHERD

539.165

8956. The disintegration of ruthenium 103 and palladium 103. J. Y. MEI, C. M. HUDDLESTON AND A. C. G. MITCHELL. *Phys. Rev.*, **79**, 429–32 (*Aug.* 1 1950).

The beta- and gamma-ray spectra of Ru^{103} (43 days), Pd^{103} (17 days) and Rh^{103m} (56 min) have been investigated in a magnetic lens spectrograph. Ru^{103} disintegrates with the emission of two beta-ray groups of end-point energies 0·684 MeV (6%) and 0·204 MeV (94%) together with a gamma-ray of 0·494 MeV and an internally converted gamma-ray of 40·4 keV energy. Pd^{103} disintegrates by orbital electron capture. The spectrum consists of an electron line at 36·9 keV, shown to be due to *L* electrons from a highly converted gamma-ray of 40·4 keV energy, together with Auger electrons. The spectrum of the metastable Rh^{103m}, whose half-life has been determined as 56 min, consists of an *L*-conversion line for a gamma-ray of 40·4 keV, with some indication of the presence of the *K* line. Ru^{97} (2·8 days) was also measured and found to emit a gamma-ray of 0·217 MeV. A

539.165

8957. The beta-spectra of Zn^{62} and Cu^{62}. R. W. HAYWARD. Letter in *Phys. Rev.*, **79**, 541–2 (*Aug.* 1 1950).

539.165 : 539.166

8958. Monochromatic positrons of internal conversion. G. D. LATYSHEV, V. V. GEI, A. A. BASHILOV AND I. F. BARCHUK. *Guide Russ. Sci. Period. Lit., Brookhaven*, **3** (*No.* 2) 37–40 (*Feb.*, 1950).

Translation of article abstracted in Abstr. 7247 (1949).

539.165 : 539.166

8959. Probability of the formation of monochromatic positrons of internal conversion. L. A. SLIV. *Guide Russ. Sci. Period. Lit., Brookhaven*, **3** (*No.* 2) 41–3 (*Feb.*, 1950).

Translation of article abstracted in Abstr. 7248 (1949).

539.165 : 537.542 : 548.0

8960. The crystal counter; a new apparatus in nuclear physics for the investigation of β- and γ-rays. I, P. J. VAN HEERDEN; **II,** P. J. VAN HEERDEN AND J. M. W. MILATZ. *Physica*, **16**, 505–27 (*June*, 1950).

For abstract see Abstr. 3437 (1948).

539.165.08 : 537.542

A counter tube for the measurement of the range curve of α-rays. *See Abstr.* 8817

539.165.2

8961. On the nature of "0–0" transitions in nuclei. I. S. SHAPIRO. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 6) 1045–8 (1950) *In Russian.*

Such transitions are considered to be related to virtual emission of a neutral meson by a nucleus and its subsequent decay. The exchange effect of the neutral meson field with nucleons is described by a constant G, with light particles by g. Then 0–0 transitions consist of 2 intermediate stages: (i) nucleus changes to a state of small energy when emitting the meson, (ii) an electron with −ve energy absorbs the meson and changes to a +ve energy state. Agreement is found with experiment for angular distribution of electron and positron emitted from an O^{16} nucleus. J. JACOBS

539.165.2

8962. Radioactive nuclei of the type M_{π}^{2z-1}. V. S. DZHELEPOV. *Dokl. Akad. Nauk, SSSR*, **62** (*No.* 1) 51–4 (1948) *In Russian.*

English translation in *Guide Russ. Sci. Period. Lit.* (*Brookhaven*) **3** (*No.* 6) 157–61 (*June*, 1950). Longer paper subsequently published [Abstr. 4966 (1949)].

539.165.2

8963. On the theory of beta-radioactivity. I. S. R. DE GROOT AND H. A. TOLHOEK. *Physica*, **16**, 456–80 (*May*, 1950).

This is developed for the case when the interaction Hamiltonian is made up of a linear combination of the relativistic invariants (scalar, tensor, vector, axial vector and pseudoscalar). Expressions are derived for the shape of the allowed β-spectrum, total probability of β^+ and β^- emission and K-capture and for the angular correlation between electron and neutrino. The β-spectrum differs from the Fermi shape by a factor of the form $(1+a/E)$ though a is zero unless the combination of invariants contains S and V together or T and A together. A symmetry principle is introduced which makes the interaction Hamiltonian the same for β^+ emission as for β^- emission (except for Coulomb effect) when the wave functions of the emitted particles (β^+ and ν or β^- and ν) are physically equivalent and the initial and final nucleon states are the same (neglecting small effects due to mass difference between a neutron and proton). This principle results in the elimination of all combinations except $S+A+P$ and $V+T$. In both cases the $1/E$ term in the spectrum shape vanishes. Present experimental data appears to confirm the absence of this term. The electron-neutrino angular correlation may be derived from the observable correlation between β-particle and recoil nucleus and such data should make it possible to distinguish between the existence of a single invariant or linear combination in the interaction. Existing evidence on He^6 is not sufficient to make this distinction. L. R. SHEPHERD

539.165.2 : 539.18

8964. On neutrino and anti-neutrino. G. F. ZHARKOV. *J. Exp. Theor. Phys., USSR*, **20**, 492–6 (*June*, 1950) *In Russian.*

It is shown that it is possible to set up a theory of β-disintegration, in which the form of the β-spectra does not allow discrimination between neutrino and anti-neutrino. The invariant Hamiltonian of the interaction of two spinor fields, represented by the wave functions ψ and ϕ, is obtained by associating the quantities of tensor character of one of the fields with the corresponding representatives of the other field. The usual forms of these expressions are bilinear combinations of the components of the wave function with their complex conjugate, there being usually 5 quantities to be considered: scalars, vectors, tensors, pseudo-vectors and pseudo-scalars. Fermi has given a tensor representation of the β-disintegration, an alternative being given by Konopinski and Uhlenbeck, the latter describing emission of an electron and anti-neutrino. However, the results of these 2 different representations are only equivalent so long as neutrino and anti-neutrino are considered as physically indistinguishable, otherwise they lead to different results. The paper shows theoretically that there cannot be a difference between neutrino and anti-neutrino in the β-disintegration. B. F. KRAUS

539.166

8965. Fine structure of the gamma lines of RaC. V. V. GEI, G. D. LATYSHEV AND M. V. PASECHNIK. *Guide Russ. Sci. Period. Lit., Brookhaven*, **3** (*No.* 2) 33–6 (*Feb.*, 1950).

Translation of *Dokl. Akad. Nauk, SSSR*, **63** (*No.* 3) 239–42 (1948) [see Abstr. 7252 (1949)].

539.166

8966. Isomerism in Pb^{204} and "memory" in angular correlation. A. W. SUNYAR, D. ALBURGER, G. FRIEDLANDER, M. GOLDHABER AND G. SCHARFF-GOLDHABER. Letter in *Phys. Rev.*, **79**, 181–2 (*July* 1, 1950).

Pb^{204*} ($\frac{1}{2}$-life 68 min) emits a gamma-ray of 905 keV to form a further excited state which decays to the ground state with a $\frac{1}{2}$-life of 3×10^{-7} sec, emitting a second gamma-ray of 374 keV. The angular correlation between the two gamma-rays was measured, using a delay of 5×10^{-7} sec and a resolving time of 2×10^{-7} sec. With the gamma-rays defined within a $\frac{1}{2}$-angle of 8°, the ratio of delayed coincidences at 180° to those at 90° was $1{\cdot}22\pm0{\cdot}05$, so that there is evidence of "memory" of spin orientation for at least $0{\cdot}5$ μsec. A. O. STANESBY

539.166

8967. The Sn^{117} isomeric activity. R. W. HAYWARD. Letter in *Phys. Rev.*, **79**, 542 (*Aug.* 1, 1950).

The observed spectrum showed two conversion peaks at $127{\cdot}0$ and $152{\cdot}5$ keV corresponding to K and L conversion for a transition with an energy of $0{\cdot}157\pm0{\cdot}002$ MeV. In order to account for the value of the K/L ratio, a mixture of 2^5 pole electric and 2^4 pole magnetic radiation must be postulated.

539.166

8968. Gamma-gamma-correlation experiments. J. R. BEYSTER AND M. L. WIEDENBECK. Letter in *Phys. Rev.*, **79**, 411 (*July* 15, 1950).

539.166

8969. Conversion lines of RaC^1. V. M. SEREBRIĬSKAYA, N. V. FORFONTOV AND V. S. SHPINEL. Letter in *J. Exp. Theor. Phys., USSR*, **20**, 573–4 (*June*, 1950) *In Russian.*

Results are given of an experimental investigation

of the lines of conversion electrons of the K-shell for gamma-rays of $h\nu = 606$ and 1 120 keV and of the K and L shells for $h\nu = 1\,414$ keV. B. F. KRAUS

539.166

8970. Internal conversion of gamma-rays with pair formation in light elements. V. B. BERESTETSKIĬ AND AND I. M. SHMUSHKEVICH. Letter in *J. Exp. Theor. Phys., USSR*, **20**, 574–6 (*June*, 1950) *In Russian.*

Gives tables of total conversion coefficients of magnetic and electric multipoles $\beta_l^m(E_+)$ and $\beta_l^e(E_+)$ corresponding to positron emission of energy E_+.

B. F. KRAUS

539.166 : 537.132

8971. The annihilation of positrons. S. MERIÇ. *Istanbul Univ. Fen. Fak. Mec., Ser. A*, **15**, 136–62 (*April*, 1950).

Angular distributions of 2-quanta annihilation radiation produced by positrons at rest were studied to give detailed results on direction, also to deduce the existence of 2-quanta annihilation in motion from the angular distribution curve; no definite conclusions are reached. One-quantum annihilation radiation resulting from annihilation of a positron by a strongly bound electron was investigated experimentally; for this the cross-section is $\propto Z^5$. Coincidence measurements were taken in 2 counters between which an Al absorber of varying thickness was inserted. The γ-ray energies were measured in terms of the range of connected electrons. It is concluded that one-quantum annihilation exists with an end-point due mainly to the Compton electrons of approx. 1·3 MeV.

J. JACOBS

539.166 : 537.531 : 537.542

Isomerism of Br^{80} and fluorescence yield of krypton. *See Abstr.* 8816

539.166 : 537.54

8972. Gamma-ray measurements with NaI(Tl) crystals. R. HOFSTADTER AND J. A. MCINTYRE. Letter in *Phys. Rev.*, **79**, 389–91 (*July* 15, 1950).

539.166.08

8973. Measurement of the gamma-ray energy of K^{40}. P. R. BELL AND J. M. CASSIDY. Letter in *Phys. Rev.*, **79**, 173–4 (*July* 1, 1950).

539.166.2

8974. Gamma-rays from Po–Be neutron source and the excited state of C^{12}. P. R. BELL AND W. H. JORDAN. Letter in *Phys. Rev.*, **79**, 392–3 (*July* 15, 1950).

539.166.2

8975. Internal conversion of the gamma-rays from Rh^{106}. F. METZGER. Letter in *Phys. Rev.*, **79**, 398 (*July* 15, 1950).

539.166.8

8976. Transition curves of 330-Mev bremsstrahlung. W. BLOCKER, R. W. KENNEY AND W. K. H. PANOFSKY. *Phys. Rev.*, **79**, 419–28 (*Aug.* 1, 1950).

Transition curves produced by 330 MeV bremsstrahlung from the Berkeley synchrotron have been measured in C, Al, Cu and Pb. The measurements were made with a thin ionization chamber "immersed" in the materials under study. The results are in agreement with expected shower behaviour. An important part of this investigation is to provide a suitable means for standardizing the synchrotron beam. This is accomplished in two ways: (1) T area of the shower curves gives a good measure of t beam energy. (2) Analysis of transition curves wi thin convertors permits separation of Compton a pair electron ionization. The pair ionization can compared with theory and the primary energy deduce Agreement between these methods is very good. As result of these measurements absolute cross-secti measurements in the synchrotron beam becor possible.

NUCLEAR REACTIONS 539.17

539.17 : 523.

Proton-neutron concentration ratio in the expandi universe at the stages preceding the formation of t elements. *See Abstr.* 8437

539.1

8977. Emulsion studies of cosmic-ray stars produc in metal foils. I. BARBOUR AND L. GREENE. Letter *Phys. Rev.*, **79**, 406–7 (*July* 15, 1950).

539.172.

8978. The angular distribution of protons from t $B(\alpha, p)C, C^*$ reaction. J. L. PERKIN. Letter in *Phy Rev.*, **79**, 175–6 (*July* 1, 1950).

539.172.

8979. The $^{11}B(\alpha, n)^{14}N$ reaction. L. E. BEGHIA M. A. GRACE AND H. HALBAN. Letter in *Proc. Phy Soc., Lond. A*, **63**, 913–14 (*Aug.*, 1950).

The neutron and gamma-ray spectra from 3 mg/cm² layer of B^{11} in contact with a 200 mc source of thickness $< 100\ \mu g/cm^2$ were measure The neutron energy distribution was deduced fro a recoil proton, pulse height analysis using a C chamber filled to 20 atmospheres. The observ spectrum was found to have a broad maximum arou 2·5 MeV. The gamma-radiation was studied by t coincidence-absorption of Compton electrons from Perspex convertor, using a pair of thin-walled gla G.M. counters and Al absorbers. A gamma-ray energy $2{\cdot}2 \pm 0{\cdot}2$ MeV was found to be present, addition to the much more intense Po gamma-radiati (0·8 MeV). This is attributed to an excited state N^{14}. Its intensity was 9% of the neutron intensity.

L. R. SHEPHE

539.172.

8980. Carrier-free radioisotopes from cyclotr targets. VII. Preparation and isolation of V^{48} fro titanium. H. R. HAYMOND, R. D. MAXWELL, W. M GARRISON AND J. G. HAMILTON. Letter in *J. Che Phys.*, **18**, 756–7 (*May*, 1950).

539.172.

8981. Carrier-free radioisotopes from cyclotr targets. VIII. Preparation and isolation of Cu^{64} from zinc. H. R. HAYMOND, R. D. MAXWELL, W. M GARRISON AND J. G. HAMILTON. Letter in *J. Che Phys.*, **18**, 901–2 (*June*, 1950).

539.172.

8982. Carrier-free radioisotopes from cyclotr targets. IX. Preparation and isolation of Re 183, 1 from tantalum. J. D. GILE, W. M. GARRISON AN J. G. HAMILTON. *J. Chem. Phys.*, **18**, 995–6 (*Ju* 1950).

539.172.13

8983. Carrier-free radioisotopes from cyclotron targets. X. Preparation and isolation of Mg^{27} from aluminum. H. R. HAYMOND, J. Z. BOWERS, W. M. GARRISON AND J. G. HAMILTON. Letter in *J. Chem. Phys.*, **18**, 1119–20 (*Aug.*, 1950).

539.172.13

8984. The emission of short range alpha particles from light elements under proton bombardment. III. The reactions $^6Li(p\alpha)^3He$ and $^7Li(p\gamma)^8Be$. W. E. BURCHAM AND J. M. FREEMAN. *Phil. Mag.*, **41**, 921–36 (*Sept.*, 1950).

The emission of short-range alpha-particles associated with the 14·8 MeV gamma-radiation produced in the $Li^7(p, \gamma)$ reaction has been established. The energy distribution of these particles can be interpreted as due to a level in the Be^8 nucleus at $3\,030 \pm 100$ keV energy, with a width of 2 000 keV. Some observations on the energy release ($3{\cdot}97 \pm 0{\cdot}03$ MeV), cross-section and excitation function for the $Li^6(p, \alpha)He^3$ reaction are also presented. A.

539.172.13

8985. Disintegration of Li^6 by deuterons. W. WHALING AND T. W. BONNER. *Phys. Rev.*, **79**, 259–61 (*July* 15, 1950).

The cross-sections of the $Li^6(d, \alpha)\alpha$ and $Li^6(d, p)Li^7$, $^*Li^7$ reactions have been measured up to energies of 1 600 keV. Evidence of a resonance level in Be^8 for 347 keV deuterons is presented. The angular distribution of the 2 proton groups has been observed at 400, 600, 1 000 and 1 400 keV. The complexity of the angular distribution increases with bombarding energy, requiring a P_6 term in the Legendre polynomial expansion at the highest bombarding energy. A.

539.172.13

8986. Proton groups from the $B^{11}(d,p)B^{12}$ reaction. W. W. BUECHNER, D. M. VAN PATTER, E. N. STRAIT AND A. SPERDUTO. *Phys. Rev.*, **79**, 262–5 (*July* 15, 1950).

Two proton groups observed when B targets are bombarded with 1·5 MeV deuterons have been identified as arising from the $B^{11}(d, p)B^{12}$ reaction. The Q-values for these groups are $1{\cdot}136 \pm 0{\cdot}005$ and $0{\cdot}189 \pm 0{\cdot}004$ MeV, showing the presence of an excited state in B^{12} at $0{\cdot}947 \pm 0{\cdot}005$ MeV. The reaction energy for the ground-state group is in good agreement with that calculated for the masses and from the B^{12} beta-rays and indicates that the primary mode of decay of B^{12} to C^{12} is between the ground states of these nuclei. A.

539.172.13

8987. The low energy neutron spectrum from $Li^7(d,n)Be^8$. W. D. WHITEHEAD. Letter in *Phys. Rev.*, **79**, 393–4 (*July* 15, 1950).

539.172.13

8988. The energy release in the reaction $^7Li(dp)^8Li$. E. B. PAUL. *Phil. Mag.*, **41**, 942–7 (*Sept.*, 1950).

The velocity of the centre of mass exceeds the velocity of the recoil nucleus in the centre-of-mass system and recoils will be observed only at angles $<$ a certain angle with the deuteron beam. This maximum angle has been observed for several deuteron energies, and the Q-value for the reaction determined to be $-0{\cdot}187 \pm 0{\cdot}010$ MeV. A.

539.172.3

8989. Observation of the photodisintegration of carbon into three α-particles. R. CHASTEL. *J. Phys. Radium*, **11**, 291–4 (*June*, 1950) *In French.*

The disintegrations were obtained during the bombardment of nuclear emulsions by γ-rays from the (p, γ) reaction in Li^7. One disintegration is described in detail, 4 others briefly. The accuracy of determination of the γ-ray energy is $\sim 3\%$, but the cross-section is very small ($\sim 8 \times 10^{-29}$ cm^2). A. O. STANESBY

539.172.3

8990. Photo-disintegration of deuterium by 4·5 to 20·3 Mev X-rays. E. G. FULLER. *Phys. Rev.*, **79**, 303–9 (*July* 15, 1950).

A study is made of the angular distributions and the distribution in energy of the photo-protons arising from the photo-disintegration of D by the continuous X-ray spectrum produced when electrons accelerated in the betatron to a kinetic energy of 20·3 MeV impinged on a 0·005 in Pt target. The collimated X-ray beam passed through a D gas-filled reaction chamber in which nuclear emulsions were placed to detect the resulting photo-protons. The angular distributions for 6 photon energy intervals are consistent with a differential cross-section in the centre of mass system of the form: $\sigma(\theta) \simeq a + \sin^2\theta(1 + \alpha\cos\theta)$. Assuming an intensity spectrum for the betatron radiation of the shape determined by Koch and Carter a curve for the relative cross-section for the photo-disintegration of D as a function of photon energy was determined. This curve falls off more slowly than does the Bethe–Peierls expression. The discrepancy, however, is within the experimental errors and the uncertainties in the spectrum of the betatron radiation. A.

539.172.3

8991. Photo-alpha-reactions in light nuclei. T. A. WELTON. Letter in *Phys. Rev.*, **79**, 399 (*July* 15, 1950).

539.172.3

8992. On the identification of the predominant photo-nuclear disintegrations in nitrogen and oxygen. E. R. GAERTTNER AND M. L. YEATER. Letter in *Phys. Rev.*, **79**, 401 (*July* 15, 1950).

539.172.3

8993. Note on angular asymmetries in (γ, n) reactions. H. L. POSS. Letter in *Phys. Rev.*, **79**, 539–40 (*Aug.* 1, 1950).

The (n, p) threshold reaction in aluminum has been used to detect photo-neutrons emitted from bismuth, lead and tungsten targets irradiated with X-rays produced by a 20 MeV betatron. Emission of photo-neutrons was found to be more prevalent at right angles to the X-ray beam than in the direction of the beam. This asymmetry for fast neutrons (the (n, p) reaction in aluminum has a threshold of 4·6 MeV for a probability of barrier penetration by the emitted proton of $\frac{1}{2}$) is in contrast to the symmetrical distributions found for lead and iron by Price and Kerst who used a detector responding to slow neutrons as well [Abstr. 5277 (1950)].

539.172.3

8994. The photo threshold of ^{208}Pb. R. W. PARSONS, D. J. LEES AND C. H. COLLIE. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 915 (*Aug.*, 1950).

539.172.3

8995. The photodisintegrations $^6Li(\gamma D)^4He$ and $^7Li(\gamma T)^4He$. E. W. TITTERTON. Letter in *Proc. Phys. Soc., Lond. A*, **63**, 915–17 (*Aug.*, 1950).

539.172.3

8996. Photoelectric dissociation of the deuteron. C. H. COLLIE, H. HALBAN AND R. WILSON. *Proc. Phys. Soc., Lond. A*, **63**, 994–1009 (*Sept.*, 1950).

The cross-section for the photo-disintegration of the deuteron has been measured by detecting the photo-protons formed in a high-pressure ionization chamber. The values obtained are $13{\cdot}91 \pm 1 \times 10^{-28}$ cm^2 for 2·62 MeV gamma-rays from radio-Th and $15{\cdot}6 \pm 1 \times 10^{-28}$ cm^2 for the 2·76 MeV gamma-rays from radio-Na. A.

539.172.4

8997. Reactions between fast neutrons and the heaviest stable nuclei (Bi, Pb, Tl and Hg). K. LINTNER. *Acta Phys. Austriaca*, **3** (*No.* 4) 352–83 (1950) *In German.*

The cross-sections for the $(n, 2n)$ reaction for fast neutrons are determined for Bi, Pb, Tl and Hg by measuring, on the one hand, cross-sections for Ra–Be neutrons, in which both absorption and the $(n, 2n)$ process are involved; and, on the other hand, cross-sections for Rn–F neutrons, which are not energetic enough for the $(n, 2n)$ reaction to take place. It is established that no significant (n, α) or (n, p) reactions occur. It is also concluded that an $(n, 2n)$ reaction takes place with another isotope of Pb as well as Pb^{204}, probably Pb^{207}. J. THEWLIS

539.172.4

8998. Successive neutron capture in gold. R. D. HILL AND J. W. MIHELICH. *Phys. Rev.*, **79**, 275–7 (*July* 15, 1950).

Transitions corresponding to 159 and 209 keV have been observed in neutron-activated Au. They have been observed to decay with a half-life of 3·3 days and have been ascribed to Au^{199}, which is formed by a process of successive neutron capture from Au^{197}. The thermal neutron capture cross-section of Au^{198} has been estimated to be of the order of 10^4 barns. A.

539.172.4

8999. Evidence for the formation of Ce^{139} by an n–γ reaction. A. J. MOSES AND D. S. MARTIN, JR. *Phys. Rev.*, **79**, 467–9 (*Aug.* 1, 1950).

A radioactivity, found in old samples of pile-irradiated Ce, can be attributed to Ce^{139} (140 days) formed by an n–γ process. This activity had a half-life of $>$ 120 days, and absorption curves indicated it possessed a larger component of X-rays than the more abundant Ce^{141} (28 days). The activity followed Ce in chemical separations from La, Ca, Ba, Pb, Fe and Zn. The ratio of cross-sections, $\sigma_{139}/\sigma_{140}$, was estimated to be 1·4. A.

539.172.4

9000. U^{235} fission yields in the rare earth region. M. G. INGHRAM, R. J. HAYDEN AND D. C. HESS. *Phys. Rev.*, **79**, 271–4 (*July* 15, 1950).

The U^{235} fission yield curve for U fuel rods from mass number 143 to 160 has been measured, utilizing mass spectrometric techniques. Eight percentage yields are assumed in this region, and on the basis of measurements of the Nd, Sm, Eu and Gd fission isotopes, 9 other yields are obtained. The resulting yield curve is smooth. Based on the same assumptions which give the smooth yield curve the following cross-sections and half-lives are obtained: Cross sections, Sm^{149}, 47 000 barns; Sm^{151}, 7 200 barns; Gd^{155}, 41 000 barns; Gd^{157}, 59 500 barns; half-lives 61^{147}, 2·26 yr; Sm^{151}, 122 yr.

539.172.4 : 537.12

9001. Search for the negative proton in fission. J. M. C. SCOTT AND E. W. TITTERTON. *Phil. Mag.*, 41 918–20 (*Sept.*, 1950).

Some $6{\cdot}5 \times 10^5$ fission tracks in photographic emulsions, representing $1{\cdot}3 \times 10^6$ fission fragment were examined. No possible annihilation tracks > 300 keV were found associated with the ends tracks. The upper limit of the probability of negative proton emission relative to delayed neutron emission from these fragments is 1 in 5 000.

539.172.4 : 539.16

9002. Neutron capture gamma-ray multiplicity. C. O. MUEHLHAUSE. *Phys. Rev.*, **79**, 277–9 (*July* 1 1950).

The average number of γ-rays, $\bar{\nu}_\gamma$, per neutron capture has been measured for about 30 isotopes. Correlations of $\bar{\nu}_\gamma$ with atomic weight and nuclear type are presented.

539.172.4 : 539.16

9003. Gamma-rays from the reaction $H^1(n, \gamma)D$ and the binding energy of the deuteron. R. E. BELL AND L. G. ELLIOTT. *Phys. Rev.*, **79**, 282–5 (*July* 1 1950).

The binding energy of the deuteron has been determined directly as $2{\cdot}230 \pm 0{\cdot}007$ MeV by measuring the energy of the gamma-radiation from the reaction $H^1(n, \gamma)D^2$. The energy of this gamma-radiation was compared with that of the 2·615 MeV gamma-ray of ThC″ by a spectrometer study of the photo-electrons ejected from a thin U radiator. The probable error of 0·007 MeV includes a probable error of 0·004 MeV in the energy of the ThC″ gamma-ray.

539.172.4 : 621.39

9004. Remote control of radioactive piles. J. POTTIER AND V. RAIEVSKI. *Onde Elect.*, **30**, 323–7 (*July*, 1950) *In French.*

Discusses, with detailed circuit diagrams, the electronic remote controlling of a U pile. The system described has been successfully used, night and day for a year. J. D. CRAGG

539.17

9005. The question of isomerism in Ca^{49}. E. DE MATEOSIAN AND M. GOLDHABER. Letter in *Phys. Rev.*, **79**, 192–3 (*July* 1, 1950).

Ca enriched to 62% in Ca^{48}, irradiated with slow neutrons, produced $\frac{1}{2}$-periods of 8·5 min and 1 h, the former ascribed to Ca^{49}, the latter to its daughter Sc^{49}. The isotopic activation cross-section of Ca was $1{\cdot}1 \times 10^{-24}$ cm^2. The Ca^{49} activity was composed of β's of energy $\sim 2{\cdot}7$ MeV and hard γ's of comparable intensity, the Sc^{49} activity being β's of 2·4 MeV. The work of Walke [*Phys. Rev.*, **52**, 7 (1937)] on the production of isomeric states of Ca was thus not confirmed. B. RO

539.174

9006. The question of isomerism in Ti^{51}. J. A. MISKEL, E. DER MATEOSIAN AND M. GOLDHABER. Letter in *Phys. Rev.*, **79**, 193 (*July* 1, 1950).

A source produced by slow neutron bombardment of TiO_2 and supposed to consist of 72*d* Ti^{51} was shown to contain Hf^{181} (46*d*) and Sb^{124} (60*d*). After purification, the Ti fraction contained 10^{-5} of the original activity. It is concluded that the supposed 72*d* period, isomeric with the 6*m* Ti^{51}, does not exist. B. ROSE

539.174

9007. On the possible effect of nuclear excitation by electromagnetic excitation of fast light nuclei. B. D'ESPAGNAT. *C.R. Acad. Sci., Paris*, **231**, 38–40 (*July* 3, 1950) *In French.*

Taking into account recent measurements of the absorption of γ-rays, it is shown, contrary to a previous paper [Abstr. 7491 (1950)], that nuclear excitation by an electromagnetic process is possible when light nuclei are bombarded by fast light nuclei. J. HUGHES

539.174

9008. A $5{\cdot}7\times10^{-9}$-sec. isomeric state in $_{77}Ir^{191}$. F. K. MCGOWAN. Letter in *Phys. Rev.*, **79**, 404–5 (*July* 15, 1950).

539.174

9009. The genetic relationship in Ag^{110}. J. MISKEL. Letter in *Phys. Rev.*, **79**, 403–4 (*July* 15, 1950).

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

9010. On the creation of mesons in multiple processes. W. HEISENBERG. *Z. Phys.*, **126** (*No.* 6) 569–82 (1949) *In German.*

The assumption that at the collision of two high-energy nucleons it is possible for many mesons to be produced in a single act by means of the non-linear terms in the Yukawa wave equation leads to certain predictions regarding the properties of those meson showers, e.g. an approximately isotropic distribution of the mesons in the C.G. reference system of the colliding nucleons, due to the "turbulent" character of the process arising from strong interactions between the mesons. The consequences of the above theory (number of mesons per shower, their angular spread) are put in a form in which they can be compared with experiment. Reasons are given why the non-linear theory should be preferred to the earlier one by Heitler. See Abstr. 2401 (1941). W. J. SWIATECKI

539.18

9011. A measurement of the positive π–μ-decay lifetime. O. CHAMBERLAIN, R. F. MOZLEY, J. STEINBERGER AND C. WIEGAND. Letter in *Phys. Rev.*, **79**, 394–5 (*July* 15, 1950).

The mesons were produced by 340 MeV X-rays falling on paraffin, and were brought to rest in a trans-stilbene crystal. The light-pulses produced by the π-, μ- and β-particles were recorded, and the time-distribution of the former pair studied. The mean life obtained is $\tau = 2{\cdot}65 \pm 0{\cdot}12\times10^{-8}$ sec. E. P. GEORGE

539.18

9012. Mesons produced in proton-proton collisions. V. Z. PETERSON. Letter in *Phys. Rev.*, **79**, 407–9 (*July* 15, 1950).

539.181.2

9013. The production of neutral mesons by photons. K. A. BRUECKNER AND K. M. WATSON. Letter in *Phys. Rev.*, **79**, 187 (*July* 1, 1950).

It is shown that the large observed cross-section for neutral meson production by X-rays [Abstr. 7502 (1950)] is not necessarily incompatible with conclusions that can be drawn from pseudoscalar meson theory if first-order radiative corrections are included. Otherwise the cross-sections for neutral and charged meson production would be in the ratio (meson mass/nucleon mass)^2 instead of being comparable. W. J. SWIATECKI

539.185

9014. Interaction of 12- to 13-Mev neutrons with deuterons. G. L. GRIFFITH, M. E. REMLEY AND P. G. KRUGER. *Phys. Rev.*, **79**, 443–9 (*Aug.* 1, 1950).

By use of a CD_4-filled high pressure cloud chamber, the angular distribution of recoils from 12- to 13-MeV neutrons has been studied. The angular range 0° to 140° in the centre-of-mass system was covered by these measurements. The distribution indicates a rather large asymmetry in the forward and backward directions with a minimum at about 60° in the centre-of-mass system. The existence of a D(n, $2n$)p reaction was evident by the presence of tracks between 60° and 90° in the laboratory system which were too long to be accounted for by either deuteron or proton elastic recoils. A.

539.185

9015. Symbolical calculation methods applicable to neutron multiplication. S. GALLONE AND C. SALVETTI. *Nuovo Cim.*, **7**, 482–500 (*July*, 1950) *In Italian.*

The thermal neutron distribution is studied in a multiplying medium containing a fast neutron source. After a short survey of the mechanism of multiplication some methods, based on a symbolical solution of the "age theory" equation, are applied to the problem. These methods are quite adequate for solving various problems concerning multiplying media of finite or infinite extent. The latter case is interesting in view of the application of the "image" method. The particular case of a cylindrical multiplying medium injected by a fast neutron point source is treated in some detail. Rapidly converging solutions are obtained. A.

539.185

9016. The coherent neutron scattering cross sections of nickel and its isotopes. W. C. KOEHLER, E. O. WOLLAN AND C. G. SHULL. Letter in *Phys. Rev.*, **79**, 395 (*July* 15, 1950).

539.185

9017. Scattering of 3·27-Mev neutrons by deuterons in the Wilson chamber. I. HAMOUDA, J. HALTER AND P. SCHERRER. Letter in *Phys. Rev.*, **79**, 539 (*Aug.* 1, 1950).

539.185.7

9018. The measurement of slow-neutron absorption cross-sections. D. J. LITTLER. *Atomics*, **1**, 189–95, 200 (*July*, 1950).

Surveys various methods of measuring absorption cross-sections for slow neutrons, including direct measurement of transmission, using monokinetic neutrons, and methods in which the effect on the reproduction constant of a nuclear pile is measured. Diffusion-length measurements are also discussed.

J. THEWLIS

539.185.75 : 778.3

9019. A new photographic method for neutron velocity spectrography. J. M. W. MILATZ, P. M. ENDT and C. H. PARIS. *Physica*, **16**, 537–44 (*June*, 1950).

In all methods hitherto used the individual neutrons are counted either by a number of mechanical registers ("channel method") or photographically ("discrete photographic method"). Advantages of using the integrating properties of the photographic plate instead of counting neutrons individually are suggested. The timing apparatus developed is simple and cheap and combines a time of flight resolution equal to that of the channel spectrometers now in use, with the useful property (in common with the discrete photographic method) of obtaining the whole velocity spectrum in one exposure. A.

STRUCTURE OF SOLIDS 539.2

539.211

9020. Fracture modes in high purity metals. T. J. AGNOR AND M. E. SHANKS. Letter in *J. Appl. Phys.*, **21**, 939–40 (*Sept.*, 1950).

539.215.4

9021. A survey of dust measurement technique. T. GAST. *Z. angew. Phys.*, **2** (*No.* 7) 301–8 (1950) *In German.*

Six different methods are summarized briefly: sedimentation, impinger methods, filtration, cyclones, electrical and thermal precipitation. 12 references.

J. M. HOUGH

539.215.4

9022. Size-frequency distributions. J. K. ALDERMAN AND B. STANDING. Letter in *Nature, Lond.*, **166**, 275–6 (*Aug.* 12, 1950).

Presents experimental results on the rate of sieving for washed river sand and Pb shot. The quantity passing the sieve/logarithmic time curves comprise 2 straight lines meeting at a very sharp transition point.

J. M. HOUGH

539.216.1

9023. Evidence against oriented structure in glass fibres. W. H. OTTO AND F. W. PRESTON. *J. Soc. Glass Techn.*, **34**, 63–8 (*April*, 1950).

Heat-treated glass fibres are shown experimentally to undergo contraction equally in the longitudinal and cross-sectional directions of the fibre, thus being shown to consist of isotropic material and without appreciably stronger longitudinal than transverse bonds. Determination of fibre strength yielde approximately the same results whether made t tensile or torsion tests, that is, under stresses applie longitudinally or at 45° to the length; and this bein so, the so-called Griffith flaws cannot be oriented any one direction.

539.219

9024. Methods of study and interpretation of th heterogeneity of ferromagnetic materials in the Ra leigh region. I. EPELBOÏN, A. MARAIS AND I DAUTREPPE. *C.R. Acad. Sci., Paris*, **231**, 222 (*July* 17, 1950) *In French.*

A.C. bridge measurements of the μ-H relation c wires and ribbons after successive electrolytic poliss ings indicate the heterogeneity of certain ferr magnetic alloys. Binary Ni–Fe alloys show a supe ficial layer of different conductivity. An explanatio is offered in terms of a non-uniform diffusion of aton during cooling after heat treatment. A. E. DE BA

539.

9025. Preparation of unbacked metallic film F. E. CARPENTER AND J. A. CURCIO. Note in *Rev. Sc Instrum.*, **21**, 675 (*July*, 1950).

539.232 : 539.16.0

9026. Preparation of thin layers of uranium oxid for radioactive measurements. E. ZIMMER. *Nuo Cim.*, **7**, 520–3 (*July*, 1950) *In Italian.*

A simple method for the electrolytic preparation thin layers of uranium compounds is described.

539.22

9027. On the oxidation of the evaporated bariu film. T. ARIZUMI AND S. KOTANI. *J. Phys. Soc Japan*, **5**, 70–5 (*March–April*, 1950).

An experimental study of a Ba getter in O_2 a air, the pressure being observed as a function of tim The resistance of the Ba film formed by flashing t getter was also measured and conclusions are dra about its structure. L. G. CARPENT

539.2

9028. On the structure and properties of some met and metal oxide films. G. H. HASS AND N. W. SCO *J. Phys. Radium*, **11**, 394–402 (*July*, 1950).

Evaporated in vacuo, Ag, Al, Si, Ge, and Al_2O SiO_2, SiO films are investigated optically and electr micrographically. Al is better suited for mirrors th Ag because the substrate is covered uniformly at sm thicknesses ($t \simeq 500$ Å): t for Ag is 1 000 Å when lar crystals are formed causing diffuse reflection. Anod ally produced Al_2O_3 films protect Al without grea reducing the infrared and visible reflectivities. T abrasion resistance of Al + Al_2O_3 mirrors is goo they cannot be damaged with rough linen, and harc scratched with metal points, but are more sensiti to boiling water and salt spray than Al + SiO mirro Amorphous Si films evaporated below 600°c crystall when heated in air or vacuo to $\sim$ 700°c. Above t the structure is completely changed: very little SiO_2 formed. Ge behaves like Si. Graphs, a diagra and electron-micrographs are given. R. A. WEA

539.

9029. An X-ray study of thermally induced stres in microconstituents of aluminum-silicon alloys. J. NIELSEN AND W. R. HIBBARD, JR. *J. Appl. Phys.*, 853–4 (*Sept.*, 1950).

539.27

9030. Apparatus for the study of insulating surfaces by electron diffraction. J. J. TRILLAT AND S. OKETANI. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 12) 148–9 (1950) *In French.*

Describes the use of a source of slow electrons for dissipating the charges formed on insulating surfaces during electron diffraction. Difficulties arising from the deposition of W from the filament are avoided by using Pt wire activated by Ba and Sr oxides, the operating temperature being only 700°C or so. ZnO (in transmission) is used as a reference substance.

J. THEWLIS

539.27

9031. Modification of electron microscope for electron optical shadow method. J. A. SIMPSON AND A. VAN BRONKHORST. Note in *Rev. Sci. Instrum.*, **21**, 669–70 (*July*, 1950).

539.27

9032. Improved ultrathin sectioning of tissue for electron microscopy. J. HILLIER AND M. E. GETTNER. *J. Appl. Phys.*, **21**, 889–95 (*Sept.*, 1950).

The use of a reservoir of liquid to collect ribbons of thin sections as they are cut enables serial sections to be obtained and provides means for detecting variations in thickness. Reducing the effects of static friction and of external vibrations makes it possible to cut long series of sections 0·2 μ thick and uniform to better than 5%. Some observations which may throw some light on the mechanics of the cutting process are reported. Mounting the sections without any treatment is shown to be superior to any technique in which the embedding material is removed or replaced. It is shown that the technique provides sections in which a structural resolution of 200 Å is possible. The remaining artifacts introduced by the sectioning and mounting are easily recognized deformations which do not influence the interpretation.

A.

539.27 : 548.538

9033. Examination of thin overgrowths by multiple scattering of electrons. L. G. SCHULZ. Letter in *J. Appl. Phys.*, **21**, 942–3 (*Sept.*, 1950).

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31

9034. On the atomic theory of elasticity. K. HUANG. *Proc. Roy. Soc.*, *A*, **203**, 178–94 (*Sept.* 22, 1950).

A scheme has recently been developed to present the general theories in lattice dynamics without specific assumptions about the atomic interactions and the present note aims at clarifying some basic points, as well as giving the correct expressions for the elastic constants. The fact is emphasized that neither the potential energy of a homogeneous deformation from a reference configuration, nor the complete stresses in the configuration can in general be represented in the general scheme. A different technique is shown to be necessary; one result is that only 5 of the stresses in an arbitrarily chosen reference configuration can be explicitly represented, namely, all the anisotropic stresses. After introducing the condition that these stresses should vanish, the expressions for the elastic constants can be obtained, which are, however, to be used subject to the condition that the remaining stress, namely, an isotropic pressure, vanishes. Only when the general theory is applied to a concrete case, can the latter condition be explicitly introduced by the use of the given interaction. The results are illustrated by the special example of central forces in the last section. The Cauchy relations follow as an incidental result; the assumptions upon which the relations rest are clearly exhibited in the simple derivation.

A.

539.31 : 548.7

9035. The Cauchy relations in a molecular theory of elasticity. I. STAKGOLD. *Quart. Appl. Math.*, **8**, 169–86 (*July*, 1950).

Born's classical discussion of the conditions required for the validity of Cauchy's relations is unsatisfactory because quadratic terms in the expression for the displacement in terms of the strains are ignored. Epstein's attempted correction [Abstr. 1008 (1947)] is only partly true, and his conclusion that the relations do not hold even for a monatomic lattice is shown to be wrong. A new discussion, using tensor theory and avoiding the serious difficulties of earlier treatments, confirms that Born's conclusions are generally true, though based on faulty arguments.

A. T. PRICE

539.311

9036. Direct study of elastic equilibrium in the presence of non-compatible deformations. F. LÉVI. *C.R. Acad. Sci., Paris*, **231**, 209–11 (*July* 17, 1950) *In French.*

The theory of the direct approach to the study of states of co-action depends on a theorem given by Colonetti [*R.C. Accad. Lincei*, **27** (1918)] and on the application of the calculus of variations. From these the equation of compatibility relative to the states of co-action is developed.

G. O. BAINES

539.32

9037. Use of the pendulum for the study of elastic properties of solids. M. LE ROLLAND. *Non-Destr. Test.*, **8**, 16–19 (*Spring*, 1950).

An instrument for measuring elastic moduli is described whose action depends on the beating of two pendula of equal period and mounted on an elastic support of the material to be tested.

G. O. BAINES

539.32

9038. The application of the phenomenon of coupled pendulums to the determination of the elastic properties and damping of solids. P. LE ROLLAND. *Ann. Franç. Chronom.* (*Sér.* 2) **4** (*No.* 2) 137–56 (1950) *In French.*

The beats of coupled pendulums, $\pi/2$ out of phase, are used to measure rigidity modulus. Two instruments based on this are described which are suitable for materials of high and low moduli respectively.

J. E. CAFFYN

539.32

9039. On the negligible changes produced in the stress-strain curve by immersion of a copper single crystal in mercury. J. B. WATCHMAN, JR. Letter in *J. Appl. Phys.*, **21**, 943–4 (*Sept.*, 1950).

539.37 : 548.7

Stability of crystalline lattices toward displacements. *See Abstr.* 9115

539.371

9040. Study of the deformation of circular elastic wires. R. CHALÉAT. *Ann. Franç. Chronom.* (*Sér.* 2) **4** (*No.* 2) 159–81 (1950) *In French.*

An energy method is used to calculate the configuration of a helical hair-spring which lies almost in one plane, when an arbitrary force and couple (not restricted to be in the plane of the spring) are applied at a certain point. The effects of gravity and centrifugal force are also evaluated, and applications to the theory of the compensated balance in a chronometer are discussed. There is good agreement between theory and experiment. J. G. OLDROYD

539.374

9041. Foundations of the mathematical theory of plasticity—and experiment. F. STÜSSI. *Z. angew. Math. Phys.*, **1** (*No.* 4) 254–67 (1950) *In German.*

Two basic assumptions in the usual mathematical theory of plasticity, namely that plastic deformation occurs without change in volume and that the plastic material behaves (quasi-) isotropically, are contradicted by certain experiments on an Al alloy "Avional." The results of experiments on thin-walled hollow cylinders subjected to superposed internal pressure, longitudinal compression, and torsion, and on the buckling of thin plates, are discussed in detail. J. G. OLDROYD

539.374

9042. Yield conditions in plane plastic stress. P. G. HODGE. *J. Math. Phys.*, **29**, 38–48 (*April*, 1950).

The stress equations for a perfectly plastic material in a state of plane stress are developed for an arbitrary yield condition. These equations are generally hyperbolic in a part of the range of admissible stresses, and may be hyperbolic, parabolic or elliptic in the remainder. The effects of slight changes in the yield condition are noted. A radially symmetric and a notched-bar problem are solved. G. O. BAINES

539.374

9043. Contribution to the study of plastic deformation in iron and soft steels. C. BOULANGER. *Rev. Métall.*, **47**, 547–57 (*July*, 1950) *In French.*

The phenomena of yield, cold shortness and ageing have been investigated by a series of tensile tests on thin wires at various temperatures. In the case of a very pure Fe, one can eliminate all the singularities peculiar to steel and then make them reappear by cementation with N, C or O. A general interpretation of the phenomena is proposed based on the mechanism peculiar to the deformation, the stresses created by the allotropic transformations and the rearrangements caused in the lattice by the inward diffusion of the added atoms. G. O. BAINES

539.374 : 536.421.1

9044. Can a metal melt temporarily during the plastic deformation? G. MASING. *Z. Metallkde*, **40**, 89–93 (*March*, 1949) *In German.*

This is a critical discussion of the problem whether a metal can melt considerably below its normal melting point as a result of the non-uniform pressure experienced in plastic deformation. Thermodynamically the contemplated large depression of the melting point can only be accounted for by assuming the presence of a semi-permeable wall. This assumption, however, is not realized in plastic deformation, rather the respective model by Gibbs, Riecke and Tammann appears to be approximately correct. Consequently, in plastic deformation the melting temperature of a metal cannot be depressed considerably. Transient melting during plastic deformation can, however, take place through local temperature increase as a result of heat generated by internal friction. APPLIED MECHANICS REVIEWS

539.374 : 548.3

9045. On the plasticity of monoclinic sulphur. W. LORENZ. *Z. Naturforsch.*, **5a**, 405–7 (*July*, 1950) *In German.*

539.374 : 66

9046. The plastic deformation of optical glass. E. W. TAYLOR. *J. Soc. Glass Techn.*, **34**, 69–7 (*April*, 1950).

A comparison was made of the impressions produced under given loads by a pyramidal-ended diamond indenter in fluorite, in calcite samples with surfaces both normal to and parallel to the optic axis and in fifteen types of optical glass. The most perfect rectangular impressions were obtained in fluorite, in the glasses a "pin cushion" being the usual shape. "Diamond pyramid hardness" numbers were calculated from the formula $(2P \sin \frac{1}{2}\theta)/d^2$, where P is the load in kg, d the average length, in mm, of the diagonals of the indentation. The highest values were recorded in the case of the barium crown glasses and the lowest in the flints, the hardness falling off with increase of lead oxide content. The displaced material resulting from indentation was piled up round the sides of the impression in a mound. Some observations were made on the furrows produced by drawing the loaded diamond point across the glass surface.

539.4.01

9047. Theory of flow hardening. A. KOCHENDÖRFER. *Z. Phys.*, **126** (*No.* 6) 548–68 (1949) *In German.*

An empirical theory to account for the increase in flow resistance observed by the plastic deformation of crystals is described, the principal features being illustrated by a model. The theory is compared with that of Mott and Nabarro and it appears that two different types of flow hardening are to be expected, these generally occur simultaneously, but only one type occurs when the deformation is pure shear.

H. J. H. STARK

539.43

9048. The flow of zinc under constant stress. A. H. COTTRELL AND V. AYTEKIN. *J. Inst. Met.*, **77** 389–422 (*July*, 1950).

Part A describes a general study of the flow of single crystals of pure Zn, under constant shear stress on the glide planes, and of polycrystalline specimens, under constant tensile stress. Flow of the single crystals occurred by slip, while that of polycrystalline specimens involved at least 4 processes, slip, twinning, cell-formation and displacement along grain boundaries. In Part B, the nature of steady-state flow i

single crystals has been examined from the point of view of the recovery theory of creep. Application of the theory to the softening of strain-hardened crystals during annealing experiments leads to the conclusion that the yield strength should decrease according to a logarithmic time relation. Measurements of the recovery of Zn crystals have given results consistent with this relation and the values of the parameters in the recovery equation agreed with those obtained from the creep experiments. A.

539.434

9049. Mechanism of primary creep in metals. W. A. Wood and R. F. Scrutton. *J. Inst. Met.*, **77**, 423–34 (*July*, 1950).

Previous work on the deformation of metals at elevated temperatures had shown that the grains dissociated into a sub-structure of elements whose size tended to an equilibrium value depending on the temperature of deformation and rate of strain, and this equilibrium condition was identified with secondary creep. The process of breakdown itself appeared therefore to be associated with primary creep, and the details of this process have been studied in the present work on annealed Al. It is shown that the mode of breakdown is determined by the rate of strain. At the higher rates, the dissociation of the grain is accompanied by a disordering of the structure which is then removed on continued deformation to reveal the fundamental sub-structure; this is referred to as a 2-stage recovery mechanism and is associated with a progressive softening of the metal. At the lower rates, the dissociation of the grain proceeds directly without intermediate disordering; this is referred to as the cell mechanism and is associated with a progressive hardening of the initially annealed grains until the equilibrium of the secondary phase is reached. The actual primary creep curve is regarded as the resultant of the two mechanisms. A.

539.434

9050. The mechanism of creep as revealed by X-ray methods. G. B. Greenough and E. M. Smith. *J. Inst. Met.*, **77**, 435–43 (*July*, 1950).

A hypothesis is put forward to explain in terms of dislocation theory the recent observations of Wilms and Wood [see Abstr. 3509 (1949)] and of Wood and Rachinger [see Abstr. 2727 (1950)] in relation to the mechanism of the deformation of metals. This mechanism is considered to be closely allied to that of the polygonization phenomenon observed by Cahn [see Abstr. 3505 (1950)], and the hypothesis incorporates many of his ideas. Some new X-ray observations are presented which offer experimental evidence in favour of the hypothesis. A.

539.434

9051. Some X-ray observations on the nature of creep deformation in polycrystalline aluminium. E. A. Calnan and B. D. Burns. *J. Inst. Met.*, **77**, 445–55 (*July*, 1950).

Back-reflection Laue patterns have been taken from the same series of locations on a large-grained Al test-piece after successive amounts of creep deformation at 250°C. From the analysis of the asterism and the movement of the reflection spots relative to the stress axis it appears that, under the conditions of the present experiments, the creep deformation up to about 3% extension in 170 hr is associated with slip processes. During this stage the striking feature of the deformation is its inhomogeneity not only from grain to grain but also within the grains themselves, so producing in many cases a comparatively coarse sub-structure. The later stages are characterized by the presence of numerous fine units or cells which are formed from the previously distorted material. A.

539.434 : 548.0

9052. Creep-time law for zinc crystals. E. P. T. Tyndall. Letter in *J. Appl. Phys.*, **21**, 939 (*Sept.*, 1950).

The creep of suitably oriented single crystals has been found to follow a very simple empirical law: $S = At^M$, in which S is the strain (non-elastic) occurring in time t, counted as zero at the instant of applying the load, and A and M are constants.

539.501

9053. The rheological law underlying the Nutting equation. G. W. Scott Blair and M. Reiner. *Appl. Sci. Res.*, **A2** (*No.* 3) 225–34 (1950).

It is shown that, by eliminating time from the Nutting equation, $\Psi = S^{\beta}\sigma^{-1}t^{k}$, this can be given a form in which both stress and strain may vary. This permits one to take account of pre-straining before the application of the stress. For certain systems which do not obey the unmodified Nutting equation, the new law is found to be applicable and the initial strain is related to stress by Bach's power law: $\sigma_0 \propto S^k$. A.

539.501 : 536.7

9054. Thermodynamics and rheological behaviour of elasto-viscous systems under stress. F. H. Garner, A. H. Nissan and G. F. Wood. *Philos. Trans. A.* (*No.* 858) 36–67 (1950).

From the break-up of expanding conical jets it is concluded that the free energy of the stressed system is higher than the free energy of the unstressed. The former was determined quantitatively from the drop in level of the liquid when a rod was rotated inside a stationary sleeve filled with the liquid; the internal energy and entropy changes were also obtained. The flow of these systems was investigated under various conditions of shear, and in all cases secondary flow from regions of high shear to low shear occurred. Flow in circular pipes exhibited a large inlet end-effect and an apparent retarding-layer effect at the wall. It is suggested that surfaces of uniform shear act as semi-permeable membranes to structural units which move from regions of high shear to those of low, thus setting up an osmotic pressure. J. E. CAFFYN

539.531

9055. The Meyer law for hardness tests. E. Jimeno and J. Terraza. Letter in *Nature, Lond.*, **166**, 359–60 (*Aug.* 26, 1950).

539.531 : 666

9056. The hardness of glass. W. H. Willott. *J. Soc. Glass Techn.*, **34**, 77–9 (*April*, 1950).

The resistance of glass to grinding and the resistance to indentation do not provide the same measure of hardness. Since resistance to grinding is of widespread importance in the glass industry, the author has attempted to measure it in terms of the volume

of glass per minute removed by grinding by a specific abrasive applied under a fixed pressure. From the "grinding hardness" (G.H.) values so obtained for glasses of differing composition, factors have been calculated for the effect of each 1% of the oxide present. The highest values are those of the glass-forming oxides silica and boric oxide. A.

539.61

9057. Adhesion of indium under static and dynamic loading. A. W. CROOK AND W. HIRST. Letter in *Research, Lond.*, **3**, 432–3 (*Sept.*, 1950).

539.62

9058. Friction. F. P. BOWDEN. *Nature, Lond.*, **166**, 330–4 (*Aug.* 24, 1950).

A review. The real area of contact of two solids is very small owing to local protuberances. These can be shown to exist by special microscopic techniques; the electron microscope and interference methods. The area in contact is almost independent of the size of the surfaces, and is proportional to the load, thus corresponding to the laws of friction. There are localized adhesions. With hard metals there is no adhesion when the load is removed because the elastic stresses in the parts of the metal adjacent to the points of contact will be released and the resulting displacement will break any junctions that have been formed. This is confirmed by experiments with soft metals such as Pb and In, where the coeff. of adhesion is almost the same as the coeff. of friction. Removal of the oxide layer on the surface of metals causes a very great increase in the friction. Local high temperatures, determined by using the sliding metals themselves as a thermocouple, may reach 1 000°C. The frictional properties of plastics are considered. The coeff. of friction for Perspex and polystyrene, which have branching side-chains, is high. Simple long-chain compounds, such as polyethylene, on the other hand, have very small coeffs. of friction. The plastic "Teflon" (polyethylene in which the H atoms have been replaced by F) has a very low coeff. of friction indeed (approximately the same as that of ice) and when incorporated in a porous metal, e.g. sintered Cu, should make a good anti-friction bearing material. A. J. MB

539.6

9059. Apparatus for rapid measurement of interna friction. H. I. FUSFELD. *Rev. Sci. Instrum.*, **21** 612–16 (*July*, 1950).

The apparatus described satisfies the conditions (*a*) low induced stress amplitude to preclude an plastic flow of the specimen; (*b*) ability to insta specimen within a few minutes after treatment (*c*) rapidity of measurement, at a rate of 10 to 20 pe minute; (*d*) accuracy of at least 1%. Longitudina vibrations are induced by an eddy-current drive similar to one previously described in the literature satisfying (*a*) and (*b*). Conditions (*c*) and (*d*) ar obtained by measuring the decay time of free vibration using vacuum tube trigger circuits and a counte chronograph. Satisfactory measurements can b made with push-button rapidity and simplicity. A

539.89

9060. Physics above 20 000 kg/cm². P. W. BRIDG MAN. *Proc. Roy. Soc., A*, **203**, 1–17 (*Sept.* 7, 1950).

Pressures up to about 50 000 kg/cm² have beer attained in a pressure vessel by using a carboloy piston and by arranging that the external force supporting the vessel increase with the interna pressure. For this purpose the vessel is given the shape of a cone fitting into a conical cavity in a massive block. By manipulating a diminutive pressure apparatus inside an outer apparatus in which a pressure of 25 000 to 30 000 kg/cm² is maintained pressures up to 100 000 kg/cm² have been obtained and their effects measured. Details of the apparatus are given. Volume changes of several elements over the whole range of pressure up to 100 000 kg/cm² showing discontinuities corresponding to poly morphic transitions, the variation of the viscosity of liquids with pressure up to 30 000 kg/cm², and the variation of the electrical resistance of metals up to 100 000 kg/cm², are discussed as examples of the work so far carried out. J. G. OLDROYD

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM . CHEMICAL REACTIONS 541.11/.12

541.121 : 535.33.07

9061. Indirect spectrophotometric method for studying chemical equilibria. L. SACCONI. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **8**, 376–81 (*April*, 1950) *In Italian.*

An expression relating the equilibrium const. of a chemical reaction with the concentrations of the participants and the e (extinction coeffs.) for a particular λ (wavelength) of light, is deduced. It is confirmed by measurements of e on a Hilger–Nutting spectrophotometer, at 19°C, using 0·1% solutions of bromocresol purple, bromothymol blue and thymol blue (acid and alkaline ranges), and the respective λ of max. absorption. Results obtained over a small pH range in each case are tabulated, and give average pK values (6·21 ± 0·04, 7·07 ± 0·05, 1·53 ± 0·06 and 9·00 ± 0·05, respectively), which are in good agreement with those recorded in the literature and obtained by other methods. J. GRANT

541.123.5

9062. Multiplication of ions by ionic exchange. A. A. GUNTZ. *C.R. Acad. Sci., Paris*, **231**, 227–8 (*July* 17, 1950) *In French.*

A multiplicity of ionic exchanges, analogous to a chain reaction, is obtainable by the use of an acidic ionic exchange agent and an insoluble neutral sal which is soluble in its acid form. The ionic exchange relationships between H ions and $CaCO_3$, $CaSO_3$ o $Ca_3(PO_4)_2$ are discussed from the above point o view. J. GRAN

541.123.5 : 539.155.2

9063. On the kinetics of isotope exchange reactions. L. WALDMANN. *Z. Naturforsch.*, **5a**, 399–400 (*July*, 1950) *In German.*

541.124 : 536.46

9064. The reactions leading to the sodium *D*-line radiation in flames. J. R. ARTHUR, D. H. BANGHAM, R. H. BAULK AND G. WHITTINGHAM. Letter in *Nature, Lond.*, **166**, 358–9 (*Aug.* 26, 1950).

541.124.7

9065. A general theory of coupled sets of first order reactions. F. A. MATSEN AND J. L. FRANKLIN. *J. Amer. Chem. Soc.*, **72**, 3337–41 (*Aug.*, 1950).

The rate equations are integrated by a method similar to that used in the determination of the normal co-ordinates of vibration of molecules. The equations for the H_2–Br_2 reaction are integrated approximately. The steady condition for H atoms and Br atoms is predicted as well as their respective steady state concentrations. A.

541.126 : 536.46

Determination of the thermal structure of a combustion wave by fine thermocouples. *See Abstr.* 8704

541.126.2 : 536.46

Determination of burning velocities. *See Abstr.* 8705

541.126 : 536.46 : 531.571

Symposium on kinetics of propellants. *See Abstr.* 8514

541.127.1

9066. A new method for the calculation of reaction velocity constants. S. WIDEQVIST. *Ark. Kemi*, **2**, *Paper* 15, 303–11 (1950).

A new method for the calculation of reaction velocity constants has been described. The method which makes use of graphical integration permits the calculation of second order reaction velocity constants without using the initial concentrations of the reacting substances. In the case of a simultaneous first and second order reaction the rate constants k_1 and k_2 may be calculated, when the initial concentrations are known. The usefulness of the method is illustrated with some examples from the literature. A.

541.128

9067. The recombination of iodine atoms in solution. R. M. NOYES. *J. Chem. Phys.*, **18**, 999–1002 (*Aug.*, 1950).

A simple theory involving jumps between lattice sites has been used to treat the recombination of atoms produced in solution by photo-chemical dissociation. The results have been applied to experimental data obtained previously on the photo-dissociation of iodine in hexane at 25°C. The treatment indicates that if a pair of atoms is separated by one molecular diameter in the dissociation process, then the probability is 0·40 to 0·50 that these atoms will recombine by diffusion in a period of 10^{-6} sec or less. The experimental data for light of 436 mμ indicate that if some of the atoms undergo "primary recombination" without escaping from the cage of solvent molecules in which they are formed, then a larger number of atoms must become separated by two or more molecular diameters as a result of the photo-dissociation. For light of 578 mμ the data and calculations indicate that about 35% of the atoms become completely separated and ultimately combine with atoms from other molecules, about 30% become separated by a molecular diameter but recombine rapidly by diffusion, and about 35% either fail to undergo predissociation or recombine without escaping from the cage of solvent molecules in which they are formed. A.

ELECTROCHEMISTRY 541.13

541.133

9068. The conductance of potassium chloride, potassium bromide and potassium iodide in aqueous solutions from 5 to 55°. B. B. OWEN AND H. ZELDES. *J. Chem. Phys.*, **18**, 1083–5 (*Aug.*, 1950).

These were measured at various temperatures and extrapolated to infinite dilution. The results, when combined with those of A. R. Gordon and others, yield limiting equivalent conductivities of each of the 3 K salts at 10° intervals between 5 and 55°C. A.

541.134 : 545.37

9069. On the significance of the slope of the polarographic wave. H. K. ZIMMERMAN, JR. AND A. H. GROPP. *J. Phys. Coll. Chem.*, **54**, 764–71 (*June*, 1950).

A method is described for determining the point of inflection of a polarographic wave. The use of this point for determining the value of E^*, the linear constant in the equation for the wave, is discussed. Some criteria for determining the reversibility of the polarographic wave on the basis of its symmetry characteristics are examined critically, and it is concluded that in dealing with polarographic data two kinds of reversibility must be distinguished. These are defined. Several examples of the application of the method to different kinds of substances are presented. It is found that, for some polarographic curves, the present method discloses the presence of previously unsuspected points of inflection. These new points of inflection are attributed to the existence of electrode processes which have never before been detected. A.

541.135 : 537.226.2

9070. Effects of dielectric saturation upon the diffuse double layer and the free energy of hydration of ions. D. C. GRAHAME. *J. Chem. Phys.*, **18**, 903–9 (*July*, 1950).

The theory of the diffuse double layer is developed for the case of a dielectric of variable dielectric constant. Using experimental data by Malsch, calculations have been made of the properties of the diffuse double layer. It is found that those properties which are experimentally significant are almost unaffected by the onset of dielectric saturation. The Born equation for the free energy of hydration of ions is elaborated to include the effects of dielectric saturation, and it is found that these effects are negligible in the case of the alkali halide ions. A.

PHOTOCHEMISTRY . RADIATION CHEMISTRY 541.14

541.14

9071. The reactions of methyl radicals. I. The photolysis of acetone. A. F. TROTMAN-DICKENSON AND E. W. R. STEACIE. *J. Chem. Phys.*, **18**, 1097–1100 (*Aug.*, 1950).

The photolysis of acetone has been investigated between 100°c and 300°c. The rates of production of carbon monoxide, methane and ethane have been measured over a range of acetone pressures from 3·9 to 100 mm and with a 30-fold variation of light intensity. The methane and ethane formed can be quantitatively accounted for by the equations $CH_3 + CH_3 = C_2H_6$, $CH_3 + CH_3COCH_3 = CH_4 + CH_2COCH_3$. It is found that $E_3 - \frac{1}{2}E_2 = 9{\cdot}7$ kcal, where E_2 and E_3 are the activation energies of the above reactions. The photolysis of deuterated acetone has also been investigated, here $E_3' - \frac{1}{2}E_2' = 10{\cdot}3$ kcal. The collision theory "steric" or "P" factor for the second reaction is less than 10^{-3} in each case. A.

541.14 : 534.321.9

Theoretical explanation of the chemical effects of ultrasonics. *See Abstr.* 8581

DISPERSIONS . COLLOIDS ADSORPTION 541.18

541.18.053 : 534.321.9

9072. Mechano chemistry of the dispersion of mercury in liquids in an ultrasonic field. E. C. MARBOE AND W. A. WEYL. Letter in *J. Appl. Phys.*, **21**, 937–8 (*Sept.*, 1950).

Dispersion of Hg in a liquid under the influence of ultrasonic vibrations requires the presence of strong forces between the metal and the medium. Strengthening the forces between the two incompatible media enhances dispersion and stabilizes the emulsion. This can be achieved in three ways: (1) Compound formation between the metal and a part of the liquid, e.g. addition of stearic acid to paraffin oil leading to a molecular film of the metal stearate. (2) Image forces induced in the metal surface by molecules with a permanent dipole, e.g. nitrobenzene. (3) Metallophilic groups such as strongly polarizable cations, e.g. Hg^{2+}. A.

541.182.4

9073. Monolayer penetration at the oil-water interface. I. Effect of salts on emulsification. R. MATALON. *Trans Faraday Soc.*, **46**, 674–6 (*Aug.*, 1950).

The enhancement of penetration in the presence of salts previously demonstrated using the monolayer technique is now shown to induce spontaneous emulsification of Nujol in water at much lower concentration of alkyl sulphate when cholesterol is present in the oil phase. The stability to creaming and flocculation of the emulsion then produced is dependent on the salt concentration and on the valency of the added cation. The flocculation of the negatively charged lyophilic oil droplets studied here is attributed to a reduction in the ζ potential and degree of hydration of the interfacial layer.

541.182.5 : 531.717.1

Apparatus for measuring the vertical swelling of colloid layers. *See Abstr.* 8517

541.182.6 : 535.43

9074. Particle size distribution in sulfur hydrosols by polarimetric analysis of scattered light. M. KERKER AND V. K. LA MER. *J. Amer. Chem. Soc.*, 72, 3516–24 (*Aug.*, 1950).

A photo-electric light scattering apparatus has been constructed which is capable of analysing scattered light, including elliptically polarized light as a function of angle of observation. The incident light may be natural or linearly polarized in any desired azimuth. Two new methods of determining particle size in the size range where the wavelength is comparable to the particle radius have been developed. They depend upon observing the polarization ratio and phase angle as a function of angle of observation. The effect of polydispersity on the higher order Tyndall spectra is discussed and theoretical calculations made to show the effect of increasing the size distribution. Stokes parameters have been utilized to set up a criterion for monodispersity. Measures of monodispersity factors (P) are presented for several sols. The values of P are less than 1, but the range of values indicates that the sols are within the size distribution limits determined by the polarization ratio method. The latter method is superior for determination of the extent of size distribution although the monodispersity factor is a valuable and useful criterion of absolute monodispersity. A.

541.182.63 : 537.533.9

Motion picture studies of electron bombardment of colloidal crystals. *See Abstr.* 8799

541.183

9075. Measurement of the adsorption of surface-active agents at a solution/air interface by a radiotracer method. D. J. SALLEY, A. J. WEITH, JR., A. A. ARGYLE AND J. K. DIXON. *Proc. Roy. Soc., A*, 203, 42–74 (*Sept.* 7, 1950).

The measurement has been made by taking advantage of the soft beta-radiation from the radioactive isotope of sulphur, S^{35}. The method depends upon the fact that, because of "self-absorption" of the radiation by the solution, and because the molecules of a surface-active agent are preferentially adsorbed at the interface, the radioactivity above a solution containing such an agent labelled with radio-sulphur should be higher than that from a solution (e.g. of Na_2SO_4) in which no surface adsorption occurs. An interesting aspect is that the rate of adsorption was followed in the low concentration ranges. The method promises to be useful for studying the kinetics of such adsorption processes, and seems to be generally applicable to surface phenomena involving adsorbed layers, either mono- or multimolecular in nature. Although this paper describes the use of S^{35} it is evident that other radioisotopes having sufficiently soft radiation, such as C^{14}, Ca^{45}, Fe^{59}, etc., could be employed. Moreover, the method appears to open

considerable possibility for examining interaction in surface layers. A.

541.183 : 530.162 : 536.71

9076. Statistical thermodynamics of critical and surface phenomena. II. Statistical theory of adsorption from regular solution. S. Ono. *Mem. Fac. Engng Kyushu Univ.*, **12** (*No.* 1) 1–8 (1950).

Using a quasi-crystalline model, an equation is derived which relates the surface excess of a component at a solid-solution interface to its concentration in solution. Numerical examples are given. The method used is that of an earlier paper [Abstr. 5971 (1949)]. S. J. GREGG

541.183 : 530.162 : 536.71

9077. Statistical mechanics of adsorption. S. Ono. *Mem. Fac. Engng Kyushu Univ.*, **12** (*No.* 1) 9–19 (1950).

The method of Ursell [*Proc. Camb. Phil. Soc.*, **23**, 685 (1927)] and Mayer [*J. Chem. Phys.*, **5**, 67 (1937)] is applied to the problem of a gas adsorbed on a solid. An equation is derived which, in principle, permits the adsorption isotherm to be obtained from a knowledge of the interatomic forces, for physical adsorption; A–A as well as A–S interactions are taken into account (A = adsorbate molecule, S = solid). A phase transition is possible under certain conditions. S. J. GREGG

541.183 : 541.128

9078. On the structure of a catalyst surface. II. R. Sips. *J. Chem. Phys.*, **18**, 1024–6 (*Aug.*, 1950).

Previous results [Abstr. 3495 (1948)] have been criticized by T. L. Hill on the ground that energies of adsorption ranging from $-\infty$ to ∞ were considered. The former theory has been revised. It appears that, if localized adsorption without interaction is assumed, the possible mathematical forms for the adsorption isotherm are very limited. The distribution function for the adsorption energy for the simplest of these has been studied in detail. It turns out that this simplest isotherm is a generalization of both the Freundlich and the Langmuir isotherms. A.

CHEMICAL STRUCTURE 541.4/.6

541.57

9079. A theoretical calculation of valence-bond parameters. J. van Dranen and J. A. A. Ketelaar. Letter in *J. Chem. Phys.*, **18**, 1125–6 (*Aug.*, 1950).

541.57

9080. The determination of bond dissociation energies by pyrolytic methods. M. Szwarc. *Chem. Rev.*, **47**, 75–173 (*Aug.*, 1950).

At the outset of this review the definition of the bond dissociation energy is given, which is followed by a brief discussion of the various relationships between this entity and other related quantities: namely, the heat of atomization, the average bond energy, the heat of radical formation, the heat of reaction and the activation energy of the reaction. This discussion is followed by a short review of various direct methods which may be applied for the estimation of bond dissociation energies. The main theme of the paper is a critical survey of various pyrolytic methods used for the determination of bond dissociation energies, the examination of principles applied in the interpretation of the experimental material and in computation of the results, and finally a review of the actual results obtained by various workers. This part is divided into two sections, the first dealing with the equilibrium method and the second with the kinetic method. The paper then concludes with a discussion of some unexplored reactions which might be used for the determination of bond dissociation energies, and with a description of various new methods which might prove useful in this type of work. Tables of bond dissociation energies and heats of formation of various radicals are given in the appendix. A.

541.57

9081. The $CH_2 : CH . CH_2–CH_3$ bond dissociation energy and the heat of formation of the allyl radical. A. H. Sehon and M. Szwarc. *Proc. Roy. Soc.*, *A*, **202**, 263–76 (*July* 7, 1950).

541.6

9082. Electron deficient compounds. V. The structure of dimethylberyllium. R. E. Rundle and A. I. Snow. Letter in *J. Chem. Phys.*, **18**, 1125 (*Aug.*, 1950).

541.64 : 530.162

9083. Statistical mechanics of dilute polymer solutions. II. P. J. Flory and W. R. Krigbaum. *J. Chem. Phys.*, **18**, 1086–94 (*Aug.*, 1950).

See Abstr. 3485 (1950). New thermodynamic relationships applicable to dilute solutions of heterogeneous high polymers are derived. The function previously given to express the interaction between two polymer molecules of equal size is modified to include chemically similar polymer molecules differing in size. With the aid of this more general pair partition function the mutually excluded volume for a pair of polymer molecules is easily computed. The osmotic pressure for a dilute solution of a heterogeneous polymer may be expressed in virial form through the application of conventional methods for treating imperfect gases. The second virial coefficient in the series expansion for the osmotic pressure is readily obtained but it is necessary to resort to the hard sphere approximation for estimation of the third coefficient. The third coefficient is much larger than was indicated by earlier theories now known to be inapplicable to dilute solutions, and plots of π/c *v.* c must be appreciably curved if the slope is great. Similar expressions are derived for Hc/τ obtained from light scattering measurements. For a dilute solution of a homogeneous polymer the value of the second coefficient in either the osmotic pressure or light scattering expression is not entirely independent of molecular weight, as predicted by earlier theories. The effect of heterogeneity on the second coefficient in these expressions is investigated for the special case of a dilute solution of two polymers differing only in molecular weight, from which it follows that the ratio of the second coefficients in the light scattering and osmotic pressure relations may be either equal to two, or greater or less than that value, depending on the heterogeneity ratio. A.

541.64 : 536.753 : 532.73

High polymer solutions. I. Vapour pressure of polystyrene soultions. *See Abstr.* 8540

LABORATORY APPARATUS 542.1/.7

542.1 : 539.16

9084. Working surfaces for radiochemical laboratories. *Industr. Engng Chem.*, **42**, 1469–81 (*Aug.*, 1950).

Glass, stainless steel, and lead. P. C. TOMPKINS AND O. M. BIZZELL. 1469–74.

The exchange of a radionuclide between surface and solution is inherently a slow process. The difficulty of decontaminating a surface depends largely on the removal of radionuclides which are firmly attached to the surface. Simple tests which permit comparisons between surfaces, decontamination reagents, and contaminating conditions have been developed. A few conclusions regarding the suitability of glass, stainless steel and lead for radiochemical laboratory surfaces have been drawn. A.

Paints, plastics, and floor materials. P. C. TOMPKINS, O. M. BIZZELL AND C. D. WATSON. 1475–80.

The corrosion resistance and decontamination properties of several available paints, plastics and resins have been studied under standardized conditions. It is concluded that some of these may be used to advantage in place of glass, stainless steel or lead for many common functions, and that they may often be decontaminated by mild reagents, such as detergents. The combination of the contaminating conditions, the surface material, and the decontamination reagent are interdependent variables which leads to a high degree of specificity in cleaning efficiency. A.

542.41 : 621.365.4

9085. A vacuum furnace for use in the temperature range 1 000–2 000°C. J. W. TOMLINSON AND J. O'M. BOCKRIS. *Rev. Sci. Instrum.*, **21**, 507–8 (*June*, 1950).

This laboratory furnace has a glass envelope and uses as heater a cylindrical grid of tungsten wire enclosed by radiation shields. A.

CHEMICAL ANALYSIS 543/545

545.37 : 621.396.615.12

9086. High-frequency titrations. W. J. BLAEDEL AND H. V. MALMSTADT. *Analyt. Chem.*, **22**, 734–42 (*June*, 1950).

Study of past instruments reviews defects and indicates the need for new approach as provided by range of instruments working at 5, 30, 100 and 360 Mc/s which indicate by means of a frequency meter detecting changes as the reaction proceeds. Constructional details are given and conclusion reached that 30 Mc/s unit is superior although the higher frequency ones were not fully investigated. Results are detailed for acidimetric, precipitation, soluble-complex and redox titrations. E. D. HART

545.37 : 621.396.615.1

9087. Stable high-frequency oscillator-type titri meter. K. ANDERSON, E. BETTIS AND D. REVINSON *Analyt. Chem.*, **22**, 743–6 (*June* 17, 1950).

Gives full constructional details of a "grid-dip instrument working at 5, 22 and 35 Mc/s. A reflectin galvanometer reads the grid current of an oscillato whose tuning capacitance is formed by electrode placed round the titration vessel. Changes i capacitance or conductivity of the liquid dielectri at the end point alter grid current. It has greate stability than previously described instruments and a accuracy suitable for most chemical purposes whe used for acidimetric or precipitation reactions.

E. D. HAR

545.37

9088. A cathode-ray polarograph. F. C. SNOWDE AND H. T. PAGE. *Analyt. Chem.*, **22**, 969–81 (*Aug* 1950).

An improved polarograph, designed aroun readily available components, is presented with som experimental results obtainable with it. The instru ment contains a sweep generator applying to th dropping mercury electrode a linear voltage swee continuous from $+0{\cdot}50$ to $-2{\cdot}50$ V, and voltage-compensating circuit which maintains th potential drop across the polarographic cell inde pendent of the drop across the series resistor. Ther is also a built-in vacuum tube voltmeter for adjustin the minimum and maximum values of the swee voltage. It is capable of following rapid, as well a slow, reactions of zero, first, and second order, an probably capable of third order reactions as well. A

545.

9089. Apparatus for chromatography and chemica analysis in ultra-violet light (ultrachemiscope). E. M BRUMBERG. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 5 885–8 (1950) *In Russian.*

The apparatus consists of (1) an ultraviolet ligh source emitting, apart from the Hg resonance lin 253 mμ, also longer wavelengths; (2) a light filte (Schott UG-5 type); and (3) a phosphorescence scree with 3 layers having different excitation and phos phorescence spectra. The 3 superposed layers ar excited by wavelength ranges < 270, 270–320 an 320–400 mμ, respectively. The colour of shadows o the screen is determined by the ultraviolet absorptio spectra of the substances placed between the ligh filter and the screen. The apparatus can be advan tageously used for absorption paper chromatograph and for spot analysis. F. LACHMA

545.8 : 539.152.

Nuclear magnetic resonance absorption in hygro scopic materials. *See Abstr.* 8916

545.8 : 539.1

9090. Use of the pile for chemical analysis. C. O MUEHLHAUSE AND G. E. THOMAS. *Nucleonics*, 7 9–17, 59 (*July*, 1950).

A review of methods of chemical analysis based o the observation of activation by pile neutron irradia tion, and on neutron scattering and absorptio measurements. Several examples of application t 2-component mixtures are given. L. R. SHEPHER

545.81

9091. Colorimetric estimation of silver. J. A. ALLEN AND D. G. HOLLOWAY. Letter in *Nature, Lond.*, **166**, 274–5 (*Aug.* 12, 1950).

Schoonover's method [*J. Res. Nat. Bur. Stand.*, **15**, 377 (1935)], using the *p*-dimethylamino benzalrhodanine colorimetric reagent, and the modified forms of it published subsequently, are unreliable. The red Ag complex does not form a true solution, and the depth of colour is, therefore, not a function of the Ag concn. J. GRANT

545.82 : 535.33.072–15

9092. Mobile infrared spectrometer. R. L. CHAPMAN AND R. E. TORLEY. *Analyt. Chem.*, **22**, 987–90 (*Aug.*, 1950).

545.82 : 535.343.3

9093. Application of photoelectric multiplier tubes to the sensitive measurement of absorption or of changes of relative light intensities. O. OLDENBERG AND H. P. BROIDA. *J. Opt. Soc. Amer.*, **40**, 381–5 (*June*, 1950).

The possibility of using photo-multipliers for the detection of the change in light intensity due to the absorption of free radicals in chemical reactions has been investigated. A discussion of the sensitivity of photo-tubes considers the effects of the random fluctuations of the photo-electric current, and the limitations due to the dark current and the fatigue of the tube. A balanced d.c. circuit using 2 photomultipliers is described. With this circuit, it is possible to detect a change of light intensity of 1 part in 10 000. A.

545.827

9094. Mass spectrometric analysis of a standard sample of carburetted water-gas by laboratories cooperating with the American Society for Testing Materials. M. SHEPHERD. *J. Res. Nat. Bur. Stand., Wash.*, **44**, 509–20 (*May*, 1950).

The results of the co-operative analysis show the reproducibility and, in certain respects, the accuracy of this powerful new apparatus for gas analysis. A.

545.827 : 539.155.2.08

9095. Application of the mass spectrometer to chemical analysis. H. VON UBISCH. *Tekn. Tidskr.*, **80**, 671–8 (*Aug.* 12, 1950) *In Norwegian.*

A brief description of the spectrometer precedes some notes on its use for analysis of gas, liquids and solids. Nitrogen and CO_2 are treated in some detail. Isotope indication is discussed and technical applications of mass-spectrographs are described.

J. A. WILCKEN

CRYSTALLOGRAPHY 548

548.0 : 535.343.2

The equilibrium between *F*-centers and higher aggregates in KCl. *See Abstr.* 8624

548.0 : 537.228.2 : 621.396.611.21

9096. A new crystalcut for quartz with zero temperature coefficient. E. J. POST. *Appl. Sci. Res.*, **B1** (*No.* 6) 420–8 (1950).

English text of paper first published in Dutch [Abstr. 2063 (1950)].

548.51 : 536.7

9097. The thermodynamics and kinetics of precipitation in solid solutions. H. K. HARDY. *J. Inst. Met.*, **77**, 457–88 (*July*, 1950).

The factors governing diffusion, fluctuations and nucleation are briefly outlined to show the manner in which the precipitation process is controlled by the free energy/composition and free energy/structure relationships. Various precipitation phenomena can be accounted for by the shape of the free energy/composition curve, from which the energy changes on precipitation can be derived. These energy changes control the mechanism of precipitation, and the rates of the various processes are determined by the energy barriers which have to be surmounted. Description of the precipitation process in terms of a hypothetical free energy/composition curve shows that stable segregates of solute atoms are to be expected as the first stage of the breakdown from high initial concentrations. These segregates possess the structure of the parent lattice and are formed by uphill diffusion. On the other hand, at low initial degrees of supersaturation stable segregates do not occur and a "transient-steady" size distribution of embryos of the new phase is set up by downhill diffusion. The time taken to set up the steady size distribution is the incubation period, and once this has been completed the critical nucleus size exerts a dominant effect on the rate of precipitation at low degrees of supersaturation. A check has been made of the Becker theory of rates of precipitation in Pb–Sn alloys and hence of the analysis setting up the Becker theory as defining the rate-controlling factor. The thermodynamic quantities for these calculations were obtained by methods used by Borelius in considering the same alloys, but from a different point of view. A.

548.53

9098. Continuous pole figure study of magnetic recrystallization. R. SMOLUCHOWSKI AND R. W. TURNER. *Physica*, **16**, 397–401 (*April*, 1950).

Experiments on a 35% Co–Fe alloy previously reported [Abstr. 601 (1950)] have been repeated, using a continuous pole figure X-ray camera. This is described, the advantages of the method over the earlier stationary method are discussed and comparative results given. The mechanism of recrystallization in a magnetic field is briefly discussed.

E. P. WOHLFARTH

548.538

9099. Oriented overgrowth of alkali halides on metals. G. W. JOHNSON. Letter in *Nature, Lond.*, **166**, 189–90 (*July* 29, 1950).

Chlorides of Na, K, Rb and Cs were crystallized from an ethyl-alcohol/water solution on metallic surfaces, the effects being observed under an optical microscope. On most polycrystalline materials some form of epitaxy occurred, in some cases very pro-

nounced. Lattice spacing and the presence of cracks and steps in the metal crystal may affect the orientation, which appears to be determined in the embryonic stages of growth. J. A. FRANKS

548.55 : 535.343.2

9100. Single synthetic zinc sulfide crystals. D. C. REYNOLDS AND S. J. CZYZAK. Letter in *Phys. Rev.*, **79**, 543–4 (*Aug.* 1, 1950).

Crystals of size $2\times2\times10$ mm were grown in a H_2S atmosphere at 1 150°C; they were of alpha-form (wurtzite). The optical absorption cut-off was at 3 350 Å, and they were entirely opaque for shorter wavelengths. A few specimens showed blue fluorescence; none showed phosphorescence.

548.57 : 621.396.611.21

9101. The manufacture of quartz oscillator plates. I. How the required cuts are obtained. W. PARRISH. *Philips Tech. Rev.*, **11**, 323–32 (*May*, 1950).

In cutting an oscillator plate out of a quartz crystal according to one of the so-called low temperature coefficient cuts, such as the AT-, BT-cut, etc., the angle tolerances for the orientation of the crystal are very small, for example only 10 minutes. The method of obtaining the desired orientation of the crystal block under the saw is explained, using the so-called *X*-block method for illustration. For a rough adjustment, methods based on the double refraction, amongst others, are used, while all ambiguity as to the direction of rotation of the saw table is eliminated by the observation of light patterns on etched crystal surfaces. Then the crystallographic position of a test cut is determined very accurately by means of an X-ray diffraction measurement and from this the required correction in the position of the saw table is deduced. The process of cutting is greatly affected by the twinning almost universally present in natural crystals. The types of twinning are briefly discussed and their influence on the "strategy" of the cutting is explained. Etching and examination at every stage of the cutting process gives greater yields and eliminates useless sawing. A.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

9102. The electrostatic lattice-energy of a neutral plane, in particular an alternating square lattice structure. O. EMERSLEBEN. *Z. Phys.*, **127** (*No.* 5) 588–609 (1950) *In German.*

The electrostatic energy of a regular arrangement of ions on a plane is calculated by a method, using Epstein's zeta-functions, similar to that used by the same author for a three-dimensional structure [*Phys. Z.*, **24**, 73–80 (*Feb.* 15); 97–104 (*March* 1, 1923)]. An arrangement of ions such as the 001-plane of rocksalt is taken as a special case. Some notes are added on the zeta-functions and their use in such calculations. A. R. STOKES

548.7

9103. A statistical partial problem regarding the problem of arrangement in two-dimensional binary mixed crystals. I. RUNGE. *Ann. Phys., Lpz.*, (*No.* 5) 240–7 (1950) *In German.*

See Abstr. 7594 (1950). The problem of th frequency of "border lines" passing through th whole square straight-line network, each of whos crossing points is transformed into a pair of hyper bolas, is treated statistically, and two numerical case are solved. F. LACHMA

548.

9104. Vibrations of an infinite linear lattice con sisting of two types of particles. II. N. S. N. NAT AND S. K. ROY. *Proc. Indian Acad. Sci., A*, **31** 330–8 (*May*, 1950).

See Abstr. 4905 (1949). The general equations c motion are solved for arbitrary initial displacement and velocities, and simplified for the special case o nearest-neighbour interactions and large values of *t*. A. J. C. WILSO

548.

9105. Physical properties of a lattice of rock-sal type built up of deformed ions. K. B. TOLPYG *J. Exp. Theor. Phys., USSR*, **20**, 497–509 (*June*, 195 *In Russian.*

The energy of interaction of adjacent ions, approxi mately represented by strongly-bound electrons, i determined as a function of their dipole moments an spacings. The equations of motion of the lattice ar solved, considering retarded interaction. Th spectrum of the eigenfrequencies of the crystal lattic for long waves differs materially from that obtaine on Born's theory. The form of the Born relatio between dielectric constant and the limiting oscilla tion frequency is here also different. Dispersion la and elastic modulus are determined for six alkali halide crystals, and the theory is compared wit experimental results. B. F. KRAU

548.

9106. Chance coincidences in the method of vecto differences. J. GARRIDO. *C.R. Acad. Sci., Paris*, **231** 297–8 (*July* 24, 1950) *In French.*

A note on the author's method [Abstr. 7613 (1950)] of obtaining a crystal structure from its Patterso transform. If the actual structure contains two o more equal interatomic vectors, extra ("parasite" atoms may appear in the deduced structure, but thes can be eliminated by further trials. A. R. STOKE

548.

9107. The electrostatic contribution to the lattic energy of some ordered spinels. F. DE BOER, J. H VAN SANTEN AND E. J. W. VERWEY. *J. Chem. Phys.* **18**, 1032–4 (*Aug.*, 1950).

The electrostatic contribution to the lattice energ of some ordered spinels is calculated. It is mad plausible that also in the case of certain spinels tha do not show any long-range ordering, a considerabl amount of short-range order is to be expected. As consequence the lattice energy of "inversed" spinel containing different ions at octahedral positions, i increased with respect to the corresponding "normal" spinels containing one type of ions at octahedra interstices.

548.7

9108. On the vibrational spectra of crystals. W. A. Bowers and H. B. Rosenstock. *J. Chem. Phys.*, **18**, 1056–62 (*Aug.*, 1950).

In order to check the accuracy of distributions of characteristic vibration frequencies in crystals as calculated by approximate methods proposed by various workers, the frequency distribution is calculated rigorously for a lattice for which this is possible, viz. a 2-dimensional square lattice with vibrations perpendicular to the lattice plane. The calculation is then repeated by the use of the various approximate methods, and comparisons are drawn. The effect of using any of the approximate distributions in place of the exact one in the calculation of thermodynamic functions is illustrated by a calculation of the specific heat of this same crystal. Finally, an extension to 3 dimensions is discussed. A.

548.7 : 517.942.93

9109. Brillouin zones and the Mathieu equation. N. S. Bayliss. *Aust. J. Sci.*, **12**, 12–14 (*Aug.*, 1949).

Many of the characteristics of Brillouin zones in crystalline solids may be demonstrated for a one-dimensional lattice by the use of the properties of Mathieu's equation. In contrast to the usual treatments of the problem which emphasize the broadening and deepening of discrete individual atoms as they are brought together to form a lattice, the author's treatment uses the concept of the gradual development of a periodic potential in a fixed lattice. The treatment does not necessitate the number of atoms being taken as very large. C. A. HOGARTH

548.7 : 530.162

9110. Investigation of the disorder-order process in the alloy Cu_3Au by measuring the electric fluctuation. E. Ya. Pumper. *Dokl. Akad. Nauk, SSSR*, **72** (*No.* 6) 1033–6 (1950) *In Russian.*

On the basis of experimental results described previously [see Abstr. 6154 (1950)] it follows that measurements of the thermo-electric force level of the fluctuation leads to a new method of analysing microscopic processes occurring in a conductor. The elevation of the level of fluctuation in relation to the level of the thermal effect characterizes the velocity of the process occurring in the conductor. The alloy Cu_3Au in the form of a wire of 0·2 mm dia. was used for testing the proposed method. The wire was converted into a disordered state by annealing in a vacuum at 600°C, after which it was tempered. The wire was then kept in an oven in which a vacuum was also maintained and was connected to the measuring instruments. In the disordered state the resistance was *c.* 3 ohms. Heating was continued at different temperatures slightly lower than the crit. temp., these temps. (330°, 370°, 395°, 415°) being maintained within ± 5°C. Under these conditions measurements of the fluctuation level were carried out. Values of the resistance and the "noise temp." (defined by a series of equations) are plotted against time of observation (32 hours). The results show that the disorder-order process for the whole of the time of observation apparently consists of two stages, the first stage lasts *c.* 4 hr and corresponds to a lowering of the fluctuation level. At this stage the curves for 330° and 370° coincide. In the second stage, which corresponds to a max. for both curves, the curves for 300 and 370 diverge. The curves for 395° and 415° confirm that the form of the curves for 330° and 370° characterize the kinetics of the disorder-order process and not any by reaction. For a small increase in the crit. temp. corresponding to annealing temps. of 395° and 415° there is an essential change in the form of the curve—instead of an initial sharp fall there is a gradual increase to a max. This method promises to give a more detailed understanding of the disorder-order process in Cu_3Au than the X-ray method or a method depending on measuring the resistance. W. HUGHES

548.7 : 530.162

9111. Crystal statistics of a two-dimensional triangular Ising lattice. G. F. Newell. *Phys. Rev.*, **79**, 876–82 (*Sept.* 1, 1950).

The thermodynamic properties of this lattice can be calculated for arbitrary interaction constants in the 3 independent directions by a simple extension of the procedure used previously by the author to solve the two-dimensional rectangular Ising lattice [Abstr. 6825 (1950)]. The triangular lattice generally has an order-disorder transition of a type very similar to that of the rectangular lattice, which is indeed but a limiting case of the triangular problem. The only lattice having no transition is that for which 1 or 3 of the 3 interactions are antiferromagnetic (—ve) and the 2 interaction constants of smallest absolute magnitude have equal absolute value. A.

548.7 : 535.343.2

9112. Theory of the *F*-centres. S. I. Pekar. *J. Exp. Theor. Phys., USSR*, **20**, 510–22 (*June*, 1950) *In Russian.*

An ionic crystal is considered, in which a conductivity electron is localized near a vacant node of the lattice which was vacated by a negative ion. The energy levels and ψ-functions of the localized electron and ions are calculated. The *F*-band of optical absorption of characteristic "bell" shape is obtained. The theory agrees satisfactorily with the experiments; it explains well the form of the absorption band, its broadening and shift towards the red when the crystal is heated, and also leads to a correct value for the thermal dissociation energy of the *F*-centre.

B. F. KRAUS

548.7 : 537.226

Low frequency dispersion in ionic crystals containing foreign ions. *See Abstr.* 8723

548.7 : 537.311.32

9113. On the nature of *V*-centres in the alkali halides. F. Seitz. Letter in *Phys. Rev.*, **79**, 529 (*Aug.* 1, 1950).

V-centres are assumed to be due to pairs of positive-ion vacancies which can trap one or two positive holes and possess metastable states. The model accounts for most of the known properties of *V*-centres.

G. J. F. GARLICK

548.7 : 537.311.32

9114. The concentration and mobility of vacancies in sodium chloride. H. W. Etzel and R. J. Maurer. *J. Chem. Phys.*, **18**, 1003–7 (*Aug.*, 1950).

The electrical conductivity of NaCl, containing CdCl as an impurity, has been determined as a

function of temperature. From these data it is calculated that the mobility of the positive ion vacancies is given by the equation $\mu = (19\,600/T)\exp(-9\,860/T)\,cm^2/V\text{-}sec$ between 250°C and 400°C. The concentration of positive ion vacancies in a "pure" NaCl crystal was $1{\cdot}0\times10^{17}\,cm^{-3}$ and independent of temperature below 550°C. A.

548.7 : 539.37

9115. Stability of crystalline lattices toward displacements. V. A. ZHDANOV AND V. F. KONUSOV. *J. Exp. Theor. Phys., USSR*, **20**, 3–15 (*Jan.*, 1950) *In Russian.*

An investigation is made of the displacement deformation undergone by a monatomic crystalline face-centred cubic lattice. It is shown that the lattice is least (and rather weakly) resistant to displacements in the (111) planes. The [112] direction suffers internal displacements during the course of the displacement. An investigation is made of the influence of the displacements of normal (unidirectional, and from all directions) tensions on the stability of the lattice.

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548.73

9116. X-ray diffraction by materials with fluid-statistical lattice irregularities. R. HOSEMANN. *Z. Phys.*, **128** (*No.* 1) 1–35 (1950) *In German.*

Lattice irregularities are divided into two classes: (i) displacements of the units from defined mean positions, as, e.g., in thermal motion; and (ii) "fluid-statistical" irregularities, in which the statistical distribution of the positions of other units is independent of the choice of the unit to which the positions are related. A very general Fourier-transform theory of scattering by a material with lattice irregularities of the second kind is developed, and it is shown how in special cases it reduces to scattering by a regular crystal, scattering by a fluid, and general scattering.

A. J. C. WILSON

548.73

9117. Special case of a direct method of X-ray structure analysis. V. V. SANADZE AND G. S. ZHDANOV. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 1) 111–12 (1950) *In Russian.*

In the vector map of centrosymmetric crystals (or projections) pseudocentres of symmetry appear at the mid-points of heavy-atom vectors. These pseudocentres have the property that the peaks related by one of them form a true picture of the atomic arrangement. The map is normally complicated by the confusion of peaks related by different pseudocentres, but in special cases, for example potassium mercury thiocyanate, the method has led to a simple direct determination of the structure. A. J. C. WILSON

548.73

9118. Summarized proceedings of a conference on X-ray analysis—Leamington Spa, 1949. C. H. CARLISLE AND A. E. DE BARR. *Brit. J. Appl. Phys.*, **1**, 161–71 (*July*, 1950).

The first session was devoted to a discussion on "The interaction of structure and chemical behaviour" and the second to "Geiger counter techniques in X-ray analysis." The papers and the discussion on them are summarized in this report. Reference also made to Professor C. A. Coulson's lecture "Chemical bonds, their shape and their behaviour" and a brief summary of Professor M. von Laue's address on "The absorption of X-rays" is included.

548.732 : 541

9119. On the discussion of crystal structure K. SCHUBERT. *Z. Naturforsch.*, **5a**, 345–6 (*June*, 195 *In German.*

In finding electron-density distributions in crysta from X-ray diffraction data, it is generally assume that the electrons behave independently; that is, the have no position-correlation. This is not necessari so; a number of structures in which there may b strong position-correlation between electrons a discussed, with special reference to various forms valency bond which occur. A. R. STOK

548.7

9120. A double-crystal X-ray goniometer f accurate orientation determination. W. L. BON *Proc. Inst. Radio Engrs*, **38**, 886–9 (*Aug.*, 1950).

The rocking-crystal goniometer has not a hig enough resolution to determine the orientation angl of AT-cut crystals to the necessary ± 3 min angle. By using a double-crystal instrument th resolution is much increased. The requirements fo accuracy are discussed, the effects of refraction an temperature being considered. It is thought that th maximum error is about 0·1 min. A. H. W. BEC

548.734

9121. Study of imperfect crystals by powder photo graphs. A. J. C. WILSON. *Research, Lond.*, **3**, 394– (*Sept.*, 1950).

A review, particularly of the theoretical interpreta tion. There are references to some 70 books an papers. A. J. C. WILSO

548.735.4

9122. On the calculation of crystal structures b Fourier series. M. DEL CARMEN AGUDO SORNÍ. *A Real. Soc. Esp. Fis. y Quím.*, **46A**, 205–14 (*May–June* 1950) *In Spanish.*

Methods of summing two-dimensional Fouri series with IBM (Hollerith) machines are described. A. J. C. WILSO

548.734

9123. Intensity correction factors for X-ray spectro meter transmission pole figure determinations. S. VA D. BEATTY. Letter in *J. Appl. Phys.*, **21**, 940– (*Sept.*, 1950).

548.735

9124. Compounds crystallizing in the Cu_5Ca typ T. HEUMANN. *Nachr. Wiss. Göttingen*, IIa (*No.* 1–6 (1950) *In German.*

See Abstr. 5127 (1949). The conditions for th formation of phases with this structure are discusse and 4 new examples with the following parameters a found: Au_5Ba, $a = 5{\cdot}66$, $c = 4{\cdot}57$; Ag_5Sr, a = 5·664, $c = 4{\cdot}610$; Ag_5Ba, $a = 5{\cdot}708$, $c = 4{\cdot}63$ Pt_5Ba, $a = 5{\cdot}494$, $c = 4{\cdot}333$ A (? *k*X). It is pr dicted that examples will be found in the systems Sr with Au, Cd, Ir, Rh, Hg, Pd and Pt, and of E with Hg. A. J. C. WILS

548.735.46

9125. Some new functions of interest in X-ray crystallography. M. J. BUERGER. *Proc. Nat. Acad. Sci., Wash.*, **36**, 376–82 (*July*, 1950).

If one interatomic vector is found from a Patterson synthesis, a new synthesis Π_2 (u, v, w) can be set up, with coefficients functions of the F's and the interatomic vector, which contains (i) peaks giving the true atomic positions, (ii) the centrosymmetric image of (i), and (iii) fortuitous peaks. The peaks (i) and (ii) map the square of the electron density, except that the peaks corresponding to the atoms separated by the interatomic vector are greatly exaggerated, and coincide if the crystal is centrosymmetric. If more than one interatomic vector is known, more complex syntheses $\Pi_3(u, v, w)$, Π_4 (u, v, w) . . . can be devised; these give a greater distortion of the electron density, but reduce the chance of fortuitous peaks.

A. J. C. WILSON

548.736.1

9126. The coordinate scheme in crystalline boron. T. N. GODFREY AND B. E. WARREN. Letter in *J. Chem. Phys.*, **18**, 1121 (*Aug.*, 1950).

548.736.4

9127. Crystal structure of ammonium bicarbonate and a possible relationship with ammonium hypophosphate. R. BROOKS AND T. C. ALCOCK. Letter in *Nature, Lond.*, **166**, 435–6 (*Sept.* 9, 1950).

548.736.4 : 536.424

9128. Thermal decomposition of nickel carbonate. J. FRANÇOIS. *C.R. Acad. Sci., Paris*, **230**, 2183–4 (*June* 19, 1950) *In French.*

Thermal decomposition of $NiCO_3$ has been shown to be accompanied by important changes in the crystal lattice, as a result of measurements by both the Debye–Scherrer and the electron-diffraction method.

F. LACHMAN

548.736.5

9129. The crystal structure of Diaboleite, $Pb_2Cu(OH)_4Cl_2$. A. BYSTRÖM AND K.-A. WILHELMI. *Ark. Kemi*, **2**, *Paper* 27, 397–404 (1950).

548.737

9130. Configuration of the tartaric ion. C. DUVAL AND J. LECOMTE. Letter in *J. Chem. Phys.*, **18**, 1117–18 (*Aug.*, 1950).

548.74

9131. Determination of oblique elementary cells in electronography. B. K. VAĬNSHTEĬN. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 1) 103–6 (1950) *In Russian.*

Electron diffraction patterns from single crystals represent sections of the reciprocal lattice. In lamellar textures each lattice point is drawn out into a circle by rotation about a reciprocal lattice vector (say c^* in a triclinic crystal). The section of these circles, which lie on coaxial cylinders, by a plane, gives a pattern of sets of arcs lying on ellipses. The distance of each arc from the centre of the pattern is measured. From arcs on one ellipse c^* and β^* can be calculated and c^* and α^* from arcs on another. The semi-axes ($\perp$ to c^*) of the ellipses correspond to the spacings A_{hk} of layers $\parallel$ to c^* in the reciprocal lattice. a^*, b^* and γ^* can be derived from 3 values of A_{hk}, thus determining the cell, although the correct axes remain to be chosen. An accuracy of $\sim 0{\cdot}02$ Å and $\sim 10'$ is claimed for measurements of cell sizes.

A. L. MACKAY

548.74

9132. Electronographic determination of the unit cell and space group of kaolinite. Z. G. PINSKER. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 1) 107–10 (1950) *In Russian.*

Electron diffraction from oriented layers of kaolinite gives the symmetry as monoclinic, with $a = 5{\cdot}14$, $b = 8{\cdot}92$, $c = 7{\cdot}34$ Å, $\beta = 103° 55'$, space group Cm. The triclinic cell of Brindley and Robinson [Abstr. 614 (1946)] is thought to be excluded; it would lead to an unobserved separation of 3 mm between the reflections 060 and $0\bar{6}0$.

A. J. C. WILSON

548.74 : 539.27

9133. Examination with the electron microscope of crystals of paraffin. L. ROBERT AND J. BUZON. *C.R. Acad. Sci., Paris*, **231**, 238–40 (*July* 17, 1950) *In French.*

The crystals are prepared by dissolving commercial paraffin wax of high melting point, 75°C, in petroleum ether. Only part of the paraffin dissolves, the remainder forming a gel which is decanted. After filtration a drop of the solution is allowed to evaporate on a parlodion film on the microscope specimen holder. Shadowing with Cr shows the crystals as a "pile" of monoclinic or orthorhombic sheets of decreasing size. The thickness of these sheets, estimated from the shadow length, is 30 Å, and it is concluded that they are monomolecular sheets of molecules standing vertical, orthorhombic (in which case they are chains of 23 C atoms) or inclined at 60°, monoclinic (chains of 30 C atoms). In addition to the crystals there appear to be regions of non-crystalline material to be seen. Two photographs are reproduced.

J. IBALL

GEOPHYSICS 55

550.312

9134. Variation of gravity with time due to the influence of the moon and the sun. H. DE CASTRO. *Ciencia, Mexico*, **10** (*No.* 1–2) 29–40 (1950) *In Spanish.*

Theoretical discussion of the variation of g with time due to the relative motion of the moon and sun for variable parallax. The values of g measured in Mexico at 15 min intervals from May 10, 1949, to May 24, 1949, agree satisfactorily with the theoretical results.

M. DOPORTO

550.34

9135. Dynamical magnification of a seismograph excited by a shock of the form $\lambda^n . e^{-\lambda\tau}\tau^n$. A. ZÁTOPEK. *Čas. Pěst. Mat. Fis.*, **75** (*No.* 2) 103–11 (1950) *In Czech.*

The purpose of this treatment is the transformation

of the curves of dynamical magnification and those of the phase lag as given in a previous paper [*Publ. Bureau Cent. Seismol. Int.*, **17**, 81–8 (1950)] into a form directly useful for the practical analysis of seismic records. This first paper gave the solution of the equation for the movement of the indicator of a seismograph with stationary mass and without solid friction under the influence of a ground shock of the given mathematical form. The curves obtained for the reduced dynamical magnification and for the phase lag of the first maximum of the actual ground movement relative to the recorded maximum are, for practical reasons, not directly applicable. A new parameter U was therefore introduced, which can be determined from a direct measurement of the first "half-period" observed on the record. The transformed curves are given as functions of U; they allow, in a relatively simple way, for the considered type of impulse to evaluate the actual ground displacement.

A. BEER

550.341

9136. Crystal shaketable for geophone studies. T. BARDEEN. *Geophysics*, **15**, 456–61 (*July*, 1950).

A comparison is made between shaketables driven by piezo-electric crystals and those of conventional design. The general construction of crystal shaketables and the auxiliary equipment necessary for geophone studies are discussed. The theory of geophone motion shows that a measurement of phase shift between the geophone output and the crystal shaketable driving voltage can be used to determine the natural frequency and damping of the moving mass of the geophone. The crystal shaketable gives a simple method for routine testing of geophones both in the laboratory and the field. A.

550.342

9137. A theory of the origin of microseisms. M. S. LONGUET-HIGGINS. *Philos. Trans, A* (*No.* 857) 1–35 (1950).

The starting point of this new theory is the work by M. Miche (1944) who showed that in the second approximation to the standing wave there is a 2nd-order pressure variation which is not attenuated with depth and which must therefore ultimately predominate over the 1st-order pressure-variations. In sections developing the mathematical theory of pressure variations in a periodic wave train and the general types of wave motion, the conditions for these 2nd-order pressure variations are evaluated. In the case of two progressive waves of the same wavelength travelling in opposite directions this variation is proportional to the product of the 1st-order amplitudes of the two waves and is of twice their frequency. Further sections consider the effect of the compressibility of the water and the problem whether the process is capable of producing the observed order of magnitude of the microseisms. It is found, indeed, that e.g. the vertical ground displacement caused by a storm area of 1 000 sq km at 2 000 km distance should be about $6{\cdot}5\mu$; this agrees well with the observed quantities. Further support to the new theory is given by work of Bernard and of Deacon.

A. BEER

550.345 : 534.222

Propagation of explosive sound in a liquid laye overlying a semi-infinite elastic solid. *See Abstr.* 857

550.3

9138. Experimental study of the geomagnet gradients as a method of clarifying various geomagnet problems. J. BOUŠKA. *Čas. Pěst. Mat. Fis.*, 7 (*No.* 2) D155–D158 (1950) *In Czech.*

The value of geomagnetic gradients is discussed pointing out that they have the same scientific an practical importance as gravity gradients. The geo magnetic gradient is a very small quantity, and thu the construction of special "gradiometers" for it measurement is no easy problem. Its solution form the basis of new fields in terrestrial magnetism.

A. BEE

550.38 : 538.12 : 523.

Origin of terrestrial and solar magnetic fields. *Se Abstr.* 8442

550.38

9139. The westward drift of the earth's magneti field. E. C. BULLARD, C. FREEDMAN, H. GELLMA AND J. NIXON. *Philos. Trans, A* (*No.* 859) 92 *pp* (1950).

The westward drift of the non-dipole part of th earth's magnetic field and of its secular variation i investigated for the period 1907–45 and the uncertaint of the results discussed. It is found that a real drif exists, having an angular velocity which is indep pendent of latitude. For the non-dipole field th rate of drift is $.0{\cdot}18 \pm 0{\cdot}015°$/year, that for th secular variation is $0{\cdot}32 \pm 0{\cdot}067°$/year. The result are confirmed by a study of harmonic analyses mad between 1829 and 1945. The drift is explained as consequence of the dynamo theory of the origin c the earth's field. This theory required the outer par of the core to rotate less rapidly than the inner par As a result of electromagnetic forces the solid mantl of the earth is coupled to the core as a whole, and th outer part of the core therefore travels westward rela tive to the mantle, carrying the minor features of th field with it. A

550.4 : 521.0

9140. Astrochemical problems in the formation of th earth. W. M. LATIMER. *Science*, **112**, 101–4 (*July* 28 1950).

Consequences of the assumption that the earth wa formed by the condensation of a cold cosmic cloud ar discussed in relation to the chemical composition o terrestrial matter and meteorites. The formation o water and the atmosphere are also considered.

R. A. NEWIN

550.837.

9141. A method of electrical profiling. K. C CRUMRINE. *Geophysics*, **15**, 477–82 (*July*, 1950).

In electrical profiling using a sensitive low-frequenc instrument, a considerable variety of information ca be obtained at relatively small expense by making suitable choice of electrode patterns for 3 measure ments at each station along a profile. Apparent re sistivities pertaining to relatively large electrod spreads can be computed from shorter sprea measurements along a profile, and a variety of poten tial drop ratios can also be computed. Suitabl

instrumentation should afford automatic recording of a variety of electrical functions in continuous profiling at or near the surface of the earth, and in bore holes. A.

ATMOSPHERE . METEOROLOGY 551.5

551.508.5 : 621.317.39.083.7

9142. A distant reading electronic anemometer and a selsyn operated windvane. A. KESAVAMURTHY AND S. P. VENKITESHWARAN. *Indian J. Met. Geophys.*, **1**, 199–206 (*July*, 1950).

551.510.4

9143. Chemical analysis of stratosphere samples from 50 and 70 km height. K. F. CHACKETT, F. A. PANETH AND E. J. WILSON. *J. Atmos. Terr. Phys.*, **1** (*No.* 1) 49–55 (1950).

By means of V2 rockets samples of air from heights ranging from 50 km to 70 km have been obtained. These have been tested for O, A, Ne and He. Except in the case of O, the results show that the composition of the air at these heights is not appreciably different from that at ground level. A large deficit of O was found but this is attributable to the method of sampling. A.

551.510.4

9144. Observations on the radium A content of the atmosphere. T. BURKE AND J. J. NOLAN. *Proc. Roy. Irish Acad.*, **53A**, 145–61 (*July*, 1950).

An examination was made by Gerdien's method of the RaA content of the atmosphere in the vicinity of Dublin over the periods March–June, 1947, and November, 1947–July, 1948. Sensitive methods were used to measure the activity of deposits and shorten the time of observation. With more observations the dependence of RaA content on meteorological and other variables was tested. The diurnal variation showed a decrease through the day to a minimum in the evening and a sudden rise to a maximum at 21–23 hr. Temperature, pressure, humidity and rainfall have little direct effect and wind is the most important. High values occur with calm conditions and decrease with increasing air movement. Atmospheric conditions favouring high RaA content favour high values for concentration of condensation nuclei and conversely. A considerable proportion of the RaA carriers have mobilities between 0·045 and 0·015 cm/sec/V/cm corresponding to those of intermediate ions and these carriers are always present. With high RaA content and high nucleus content, some of the carriers have mobilities less than those of intermediate ions. Owing to (*a*) absence of equilibrium and (*b*) the associated variation of the radioactive and nucleus contents of the air, none of the equations proposed for the relation between nucleus content and conductivity for the lower layers of the atmosphere can be valid. R. S. READ

551.510.535

9145. 27-day variations in F_2 layer critical frequencies at Huancayo. J. BARTELS. *J. Atmos. Terr. Phys.*, **1** (*No.* 1) 2–12 (1950).

The solar radiation responsible for the production of F_2 layer ionization is already known to change with the 11-year sunspot cycle. The question has therefore been examined whether analogous changes occur in the course of the solar rotation of about 27 days' period in cases where the sunspot numbers R show appreciable quasi-persistent periodicities. After correcting for lunar tidal influence, variations of the type in question have been found in the noon values of fF_2 for Huancayo, Peru, using the superposed epoch method. Such variations are found to be of the order of 6 to 10%. Changes in fF_2 accompanying changes in R appear to be delayed by about two days, but a scatter analysis by means of synchronized harmonic dials throws doubt on the statistical significance of such a lag. The lunar tides in the noon values of fF_2, examined for comparison, cause total semimensual changes of more than 10% in southern summer, but only 2 to 3% in southern winter. These seasonal changes in the lunar tidal effect $L(fF_2)$ are much larger than those disclosed in the quantitative effects of changes of R on fF_2. The use of these results in ionospheric forecasting is briefly discussed. A.

551.510.535

9146. Studies of the height oscillations of the F_2-layer. II. O. BURKARD. *Geofis. Pura Appl.*, **16**, 117–22 (*April–June*, 1950) *In German.*

The records of 8 stations show that the minimum height of the layer shows a variation with a period of half the sunspot cycle. A Peruvian station, Huancayo, shows a large variation with the same period as the sunspot cycle superimposed on this double peaked variation. J. M. HOUGH

551.510.535

9147. Studies of the height oscillations of the F_2-layer. III. O. BURKARD AND R. EYFRIG. *Geofis. Pura. Appl.*, **16**, 123–7 (*April–June*, 1950) *In German.*

It is necessary to distinguish between the minimum height and the height of maximum electron concentration in the $F2$-layer. Near the equator there is a considerable difference between these heights, and the height of maximum electron concentration increases with the number of sunspots while the minimum height decreases. J. M. HOUGH

551.510.535

9148. Thickness data for the F_2 layer of the ionosphere for the parabolic model. E. THEISSEN. *Naturwissenschaften*, **37** (*No.* 14) 334–5 (1950) *In German.*

A summary of the conclusions reached after a 10-year experimental investigation at Kochel and Freiburg using this model. J. M. HOUGH

551.510.535

9149. Ionospheric observations in Adélie Land. M. BARRE AND K. RAWER. *C.R. Acad. Sci., Paris*, **231**, 436–7 (*Aug.* 16, 1950) *In French.*

A preliminary report on the first investigation made, in the Antarctic circle in the neighbourhood of the South Magnetic Pole, by the expedition of Commandant Charcot. J. M. HOUGH

551.510.535

9150. Large-scale sporadic movements of the *E*-layer of the ionosphere. N. C. GERSON. Letter in *Nature, Lond.*, **166**, 316–17 (*Aug.* 19, 1950).

Radio amateurs in North America have been studying sporadic reflections from the *E*-layer on

50 mc/s. Some preliminary results for the period May 15–16, 1949, are presented; these show the existence of 4 reflecting regions over North America which moved with velocities of up to 200 km/hr.

J. M. HOUGH

551.510.535

9151. Diffusion in the ionosphere. M. H. JOHNSON AND E. O. HULBURT. *Phys. Rev.*, **79**, 802–7 (*Sept.* 1, 1950).

Diffusion is treated by showing that the action of a medium on a diffusion gas is that of a dissipative force. When the theory is applied to an electrically neutral ionic gas in a gravitational field, it is found that the mixture of positive and negative ions diffuses as a single gas because of the electrical polarization charges within the ionic cloud. In the presence of a magnetic field, the diffusion cannot be expressed in terms of the ionic density until the electrodynamical equations governing the flow of electrical current have been explicitly solved. Solutions are obtained for special cases which show that a strong magnetic field completely inhibits the diffusion due to concentration gradients in the transverse plane and has little effect on the diffusion due to the gravitational force. A.

551.510.535 : 523.53

Comparison of meteor activity with sporadic *E*-reflections. *See Abstr.* 8440

551.511 : 525.35

On the seasonal fluctuations of the rotation of the terrestrial globe. *See Abstr.* 8467

551.515.2

9152. A model of hurricane formation. H. RIEHL. *J. Appl. Phys.*, **21**, 917–25 (*Sept.*, 1950).

The description of the energy cycle of the mature tropical storm is amplified on the basis of recent upper air observations. Air particles passing through such a storm at first undergo isothermal expansion as they move toward a centre. Then they ascend with release of condensation. At high levels they move outward and mix with the environment giving off heat to the surrounding colder air. Several requisites for maintenance of the observed temperature field are stated. After a discussion of previous theories of hurricane formation the proposed model is described. The initial intensification of the wind field is brought about by mass divergence at high levels that imposes a pressure reduction on the surface layers. This divergence is the result of interaction between the large-scale disturbances of the upper air inside and outside the tropics. A solenoidal circulation is initiated that acts in the kinetic-energy-producing sense. But this circulation contains an internal mechanism for its own destruction and is maintained only under certain special conditions which are stated. A.

551.552

9153. A re-examination of the "Leipzig Wind Profile" considering some relations between wind and turbulence in the frictional layer. H. LETTAU. *Tellus*, **2**, 125–9 (*May*, 1950).

The "Leipzig Wind Profile" is a unique example of a representative wind distribution in the frictional layer which resulted from Mildner's set of 28 pilot-balloon observations with two theodolites on October 20, 1931, near Leipzig for a stable weathe situation. It is shown that the vectors of geostroph motion and ground drag follow from the wind profi when a scalar "austausch" is assumed. The re computed vertical austausch-distribution indicate that the energy for maintaining the turbulence in steady frictional wind profile is taken from the poter tial energy of the horizontal pressure field by means c the steady flow of air across the isobars. A

551.552 : 534.2

9154. The fine structure of atmospheric turbulence i relation to the propagation of sound over the ground E. G. RICHARDSON. *Proc. Roy. Soc., A*, **203** 149–64 (*Sept.* 22, 1950).

With the aid of hot-wire instruments, measuremen have been made of the fluctuations of the wind in th lowest 50 ft of the atmosphere and, in particular, c the mean eddy diameter and of the ratio of vertica and cross-wind components in such fluctuations. appears that the turbulent elements near the groun are smaller in size and more nearly isotropic i character than those higher up. Some correlatio between the temperature and velocity fluctuation near the ground has been observed. Simultaneou measurements of the fluctuations in sound intensit at a distance from a steady source and of the inter vening gustiness have been made in order to discuss th relation between sound scattering and backgroun noise, on the one hand, and the intensity and scale c the prevailing turbulence on the other. The effect c the latter on the phase relationships between th signals picked up at two points is also demonstrated A

551.574

9155. Size and charge distribution of atmospheri condensation nuclei. P. J. NOLAN AND D. J. DOHERTY *Proc. Roy. Irish Acad.*, **53A**, 163–79 (*July*, 1950).

The nucleus concentration was measured by mean of a photo-electric counter and the diffusion coefficien was obtained by the Nolan–Guerrini method. Th radii of the nuclei was deduced from the diffusio coefficients by means of the Stokes–Cunningham Millikan relation. The radius deduced from th diffusion coefficient varies from 1×10^{-6} to 6×10^{-6} cm Smaller values are observed in summer and longe during fogs. Most winter observations varied fro 2×10^{-6} to $3{\cdot}5\times10^{-6}$ cm. Concurrent observation of radius and charge-distribution indicate that th fraction of charged nuclei is usually less than th equilibrium value determined by Nolan and Kenna Experiments with room nuclei support the hypothes that the lack of equilibrium in outdoor air is due t insufficient time between production and measure ment. The variations with time of the size and charge distribution of stored atmospheric nuclei suppor conclusions about the lack of equilibrium in atmo spheric air. The effect of the charge-disequilibriu of atmospheric nuclei on ionization balance equation is examined. R. S. REA

551.578.

9156. Control of precipitation from cumulus cloud by various seeding techniques. I. LANGMUIR. *Science* **112**, 35–41 (*July* 14, 1950).

A discussion of the normal formation of cumulu

clouds under natural conditions with their characteristics varying according to latitude shows that two conditions must be fulfilled before heavy natural rain can be obtained, viz. (1) the synoptic condition must be favourable, and (2) there must be a concentration of sublimation nuclei to generate sufficient heat in the cloud to overcome stability and produce turbulence. The results of seeding experiments in New Mexico on October 14, 1948, and July 21, 1949, are analysed. In the treatment the relationship $R/R_0 = e^{(-C_1/C)}$ has been employed where R, the average rainfall in a 24-hour period, is taken as a measure of the probability of shower formation, R_0 the maximum average rain that could be produced over the area by the optimum concentration of nuclei, C the actual concentration and C_1 the concentration needed to make $R/R_0 = 1/e$. The 2 days selected were chosen because conditions were very similar both as regards the synoptic situation and the method of seeding, AgI being used on both dates. From the analysis it is concluded that the AgI seeding produced practically all the rain in the state of New Mexico on these 2 days. But to obtain useful statistical data in different localities and under different synoptic conditions, regular tests throughout the year will be necessary. A. E. M. GEDDES

551.583.3 : 523.875

Secular changes of stellar structure and the ice ages. *See Abstr.* 8458

551.593

9157. The attenuation of brightness contrast caused by atmospheric optical haze. H. S. COLEMAN AND H. E. ROSENBERGER. *J. Opt. Soc. Amer.*, **40**, 507–8 (*Aug.*, 1950).

Convection currents of small local air masses of a variety of optical densities which cross a line of sight momentarily deflect the line of sight from the object to its background, thereby changing the apparent contrast of the object viewed. This attenuation process is designated as "optical haze" (or "shimmer") to distinguish it from reduction in contrast caused by scattering processes. In the case of a black object viewed against the horizon as a background, the intensity of optical haze has been found to vary with time throughout the day. During the afternoon minimum, the optical haze was found to practically vanish so that the two attenuation processes could be isolated on days in which the scattering was reasonably constant. Studies of the relative importance of the two physical attenuation processes mentioned have indicated that as much as 50% of the atmospheric attenuation of brightness contrast can be attributed to optical haze. This suggests a need for modifying the theoretical treatment of the subject of atmospheric attenuation. A.

551.593.9

9158. Nature of the infra-red radiation of the night sky. V. I. KRASOVSKIĬ. *Dokl. Akad. Nauk, SSSR*, **73** (*No.* 4) 679–82 (1950) *In Russian.*

551.593.9

9159. Determination of the height of the luminous atmospheric Na layer in twilight. G. CARIO AND U. STILLE. *Abh. Braunsch. Wiss. Gesell.*, **2**, 40–66 (1950) *In German.*

From the results of spectrophotometric measurements of the twilight *D*-line emission, made in 1941, a mean thickness of $11{\cdot}5 \pm 6{\cdot}5$ km is found for the atmospheric Na layer, with an upper limit of $118 \pm 2{\cdot}5$ km. The observations suggest excitation by u.v. radiation to which the atmospheric O_3 layer is opaque, and give an upper limit to this layer of 54 ± 3 km. D. R. BARBER

551.593.9

9160. *OH* emission bands in the spectrum of the night sky. II. A. B. MEINEL. *Astrophys. J.*, **112**, 120–30 (*July*, 1950).

See Abstr. 7121 (1950). A detailed analysis has been made of the vibrational constants for the ground state of OH, combining the observations of the night-sky rotation-vibration bands with laboratory data for the ultraviolet electronic OH bands. Systematic deviations were observed from the band positions predicted by ω_e and $\omega_e x_e$ from the ultraviolet bands. The deviations show, however, that the assignment of terms in $\omega_e y_e$, $\omega_e z_e$, . . ., would not have any physical significance. The relative intensities have been determined for the night-sky bands from 9 000 to 5 500 Å. The resultant values show systematic changes of band intensity within each Δv sequence. A brief investigation of the band intensities under conditions of radiative equilibrium for cases of resonance and thermal excitation shows that the OH bands are probably produced by a chemical resonance mechanism and, further, that collisional de-excitation effects may be present. The temperature in the OH stratum was found to be $260° \pm 5°$K from the distribution of energy in the resolved P branches and from the ratio of intensity between the P, Q and R branches. A.

551.593.9

9161. The ^4S–^2D line of nitrogen observed at twilight. G. COURTÈS. *C.R. Acad. Sci., Paris*, **231**, 62–3 (*July* 3, 1950) *In French.*

The emission line at 5 199 Å, due to the ^4S–^2D transition of atomic N, which has been observed previously in the spectra of high- and low-altitude aurorae, has now been observed for the first time in the twilight sky spectrum on 3 occasions in January 1949. On 4 other dates in the same month the line was invisible, and its presence in the night-sky spectrum has not been established. D. R. BARBER

551.593.9 : 535.242

9162. A visual photometer for measuring the brightness of the night sky. R. TOUSEY, M. KOOMEN AND L. DUNKELMAN. *Trans Amer. Geophys. Un.*, **31**, 547–8 (*Aug.*, 1950).

The instrument described is suitable for night operation in high latitudes. It has no electrical circuits or lamps, and has a lower brightness limit of about $0{\cdot}010\ \mu$L. A phosphor button serves as the comparison source. A.

551.594.12

9163. The ionization balance of the atmosphere. V. F. HESS AND R. P. VANCOUR. *J. Atmos. Terr. Phys.*, **1** (*No.* 1) 13–25 (1950).

Two methods were developed for determining the residual ionization in brass chambers and the absolute ionization of the hard and the soft component of cosmic radiation in the atmosphere at sea level, without secondaries from the walls of the chambers. It was found that, on the average, the hard component

(filtered through 10 cm of iron) produces an ionization of 1·51 *I* while the total intensity (hard + soft component) amounts to 1·88 *I*. The effect of the gamma-rays from the radioactive substances floating in the atmosphere was determined by a new method, described in this paper. This "air radiation" amounts to about 0·15 *I*, varying considerably from day to day. Another set of experiments was carried out to find the ionization produced by the alpha rays from radon, thoron, and their subsequent products. It was found that radon and its subsequent products give 0·93 *I*, while thoron and its products give 0·83 *I*. The latter, therefore, contribute 47% of the total ionization by alpha rays. The radon content itself was 46×10^{-18} curie per cm³ (average of November and December). The ionization by gamma rays from the ground amounted to 3·0 *I*. The contribution by beta rays from radium, thorium and their decay products in the ground and in the atmosphere was estimated as 0·4 *I*. The total ionization, on the point of observation, 1 m above ground, consisted therefore of the following four components: alpha rays 1·76 *I*; beta rays 0·40 *I*; gamma rays 3·15 *I*; cosmic rays 1·90 *I*; total 7·21 *I*. Using the linear law of recombination of small ions which holds for air polluted with a great number of nuclei, and taking the lifetime as 10·6 sec (from a recent determination at the same location), one would get less than 100 small ions per cm³ present in the stationary state. A.

551.594.13

9164. Atmospheric electrical daily variations and air masses. H. Israël. *J. Atmos. Terr. Phys.*, **1** (*No.* 1) 26–31 (1950) *In German.*

The relation between the mean daily variation of the columnar resistance (resistance of a vertic column of air of 1 cm² cross-section reaching fro the ground up to the conducting layer) and air mass has been investigated, using atmospheric-electric da from Wahnsdorf/Dresden 1934–37. The daily vari tion of this resistance is found, in summer, to be near the same for the 4 main air masses considered, *P*, *M*, *C* and *T*, with a minimum near 0800 a.m. and maximum in late afternoon. In winter the variatic of the resistance for the air masses *M*, *C* and *T* approximately inverse to that experienced in summe while the variation for the polar air mass *P* shov quite different characteristics. No explanation fo this difference can at present be given.

551.594.5 : 521

9165. Application of the methods of celesti mechanics to Störmer's problem. G. Lemaître. *An Soc. Sci. Brux.*, **64** (*No.* 1–2) 76–82 (1950) *In French.* See Abstr. 6618 (1949). The mathematical theo of "intermediate orbits," corresponding to harmon motion in which the charge moves at a constant di tance from the magnetic dipole, is further develope by introducing new sets of conjugate variables.

R. A. NEWIN

551.594.6 : 621.396.826 : 621.396.

9166. Well-defined ionization clouds at a height 125 km during an aurora. [Sporadic *E*-echoes D. Stranz. *Arch. elekt. Übertragung*, **4**, 213– (*June*, 1950) *In German.*

Detailed description of normal incidence ion spheric observations made at Göteborg and Kirun (Sweden) during an aurora on the night of Se tember 16–17, 1948. W. J. G. BEYNON (

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MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

61 : 539.16

9167. Some applications of nuclear physics to medicine. W. V. Mayneord. *Brit. J. Radiol.* (*Suppl. No.* 2) 290 *pp.* (1950).

An authoritative survey of the whole field of nuclear physics applied to medicine; exhaustive bibliographies, tables and references are supplied. Includes general properties of nuclear particles and transformations. The chain-reacting pile is considered in brief theory, practice and significance, with medical use of radio-isotopes and fission products, tables of isotopes, their energies and particle ranges. Supply from Harwell and U.S.A. is described. Production, measurement, therapeutic and diagnostic uses of radioactive P, I, Fe and Na are described. Absorption mechanism at high energies, and absorption coefficients in tissue are given. Dosimetry of β- and γ-ray emitters leads to mathematics of radiation distribution due to emitters of various shapes. Integral and tolerance doses for radio-isotopes, and general counter dosimetry are presented. Properties of Co^{60}, and possibilities of 1 000 curie sources for teletherapy are considered. Basic principles and practice of the betatron, synchrotron an linear accelerator are supplemented by measuremen of Mayneord and Martin with machines in Englan and U.S.A. These include absorption curves in C Al and Pb from 4–14 MeV and changes in quali within scattering medium. Use of energy units f radiation measurement is discussed. Protecti measurements, with ionization chambers and filr up to 12 MeV, are backed by details of Pb and concre required. γ-ray counting with calcium tungsta crystals (Mayneord and Belcher) is described, an efficiency compared with Geiger counters.

D. V. MAB

612.

9168. On the natural position of the crystalline le and the principal cause of nocturnal ametropia. J. M Otero, M. T. Vigón and D. Gálvez. *An. Re Soc. Esp. Fis. y Quim.*, **46A**, 227–30 (*July–Aug.*, 195 *In Spanish.*

The Purkinje images for 3 subjects have be photographed using a flash of 2×10^{-4} sec after th eye had been in complete darkness for 40 min. Th size of the second image for various accommodatio was determined and is shown graphically. Proof obtained that the rest position of the crystalline le

for a normal eye corresponds to a mean accommodation of 1·25 dioptre, and the main cause of night myopia is attributed to this. S. WEINTROUB

612.84 : 628.9.037

9169. Provisional communication on investigations concerning the quality of illumination (incandescent *v.* fluorescent light). B. KNUDSEN. *Tidskr. Ljuskultur*, **22** (*No.* 2) 60–6 (1950) *In Danish.*

A report on experiments for ascertaining the effects of fluorescent and incandescent lighting (1) on amount of office work (counting of telephone-call coupons) produced, and (2) physiological vision, *minimum separabile*, form sense, contrast sense, (3) various operations carried out under laboratory conditions such as threading a needle, vernier-reading, accommodation time. The two lighting-types appear to be equivalent. J. A. WILCKEN (R)

612.843.52

9170. Preliminary report on a device for the objective measurement of the negative afterimage phenomenon. H. LEHMANN. *Science*, **112**, 199–201 (*Aug.* 18, 1950).

Bidwell's apparatus [*Proc. Roy. Soc.*, *A*, **61**, 268 (1897)] is modified by introducing a source of light of variable brightness. The apparatus and experimental procedure are described. [Since the subject must report on his or her sensations the measurement is not objective in the accepted sense of the word.]

R. A. WEALE

612.843.63

9171. The minimum visual acuity at threshold values. J. M. OTERO AND M. AGUILAR. *An. Real Soc. Esp. Fis. y Quim.*, **46A**, 197–204 (*May–June*, 1950) *In Spanish.*

The visual acuity under conditions of scotopic vision approaches a limit asymptotically when the brightness of the visual field approaches the threshold. Four observers were tested at 5 100 Å (rod vision; scotopic max. of sensitivity) under standard test conditions. At the threshold the visual acuity is inversely proportional to the subtended angle and practically independent of the field brightness in these tests. Limits of brightness: $5{\cdot}5\times10^{-5}$ to $1{\cdot}56\times10^{-5}$ apostilb. W. SUMMER

612.843.63

9172. On the effect of the pupillary diameter and entoptic images on the perception of detail. A. ARNULF, O. DUPUY AND F. FLAMANT. *C.R. Acad. Sci., Paris*, **231**, 304–6 (*July* 24, 1950) *In French.*

Optimal foveal contrast acuity is achieved at a pupillary diameter $\omega = 0{\cdot}7$ mm with a test-field of constant luminance, but at $\omega \sim 0{\cdot}2$ mm with constant retinal illumination. Results are given for different kinds of test-field, different contrasts, and for rotating and stationary pupils. The rotating pupil considerably improves the perception of weak contrasts.

R. A. WEALE

612.846.1

9173. The investigation of eye movements. M. P. LORD AND W. D. WRIGHT. *Rep. Phys. Soc. Progr. Phys.*, **13**, 1–23 (1950).

An objective survey is made of the experimental techniques available for the study of eye movements; the discussion includes a criticism of the validity of the various techniques. The methods are: (1) after-image experiments, (2) counting techniques, (3) direct visual observation of the eyeball, (4) recording by means of an attachment to the eye, (5) photography of the eyes, (6) recording of the corneal reflex, (7) recording of the corneal-retinal potential difference.

L. S. GODDARD

612.85

9174. The informational capacity of the human ear. H. JACOBSON. *Science*, **112**, 143–4 (*Aug.* 4, 1950).

The author attempts a quantitative specification, using new concepts of the nature and measure of information. He employs Gabor's "logons," or elementary signals, Riesz's j.n.d.'s (just noticeable differences), distinguishable tones per sec ($1{\cdot}3\times10^6$), and "bits" (binary digits per sec). He concludes: "Since about 29 000 ganglion cells are to be found in a cochlear nerve, we observe about 0·3 bit/sec of information per nerve fibre. If the capacity is taken as $1{\cdot}3\times10^6$ distinguishable tones per second, then about 40 tones per sec can be accounted for by each fibre. This is about 10% of the maximum number of impulses which an adapted nerve fibre can carry." A. B. WOOD

612.85

9175. The masking of clicks by pure tones and bands of noise. I. J. HIRSH, W. A. ROSENBLITH AND W. D. WARD. *J. Acoust. Soc. Amer.*, **22**, 631–7 (*Sept.*, 1950).

Results indicate that it is difficult to generalize about the masking of clicks by pure tones from observations on only a few observers because of sizeable individual differences. The masking of clicks by noise, however, is related unambiguously to the intensity and the spectral distribution of the noise. Both pure tones and narrow bands of noise provide maximum masking in the region between 1 000 and 3 000 c/s. Generally speaking, noise is a more efficient masker of clicks than are single pure tones. Although the present measurements were made with masking frequencies below 6 500 c/s, there is some preliminary evidence to suggest that the audibility of certain clicks in noise is markedly dependent on frequencies above 6 500 c/s. The linear (slope = 1) relation between the masking of speech or pure tones by noise and the intensity of the noise does not apply here. Rather a trimodal function indicates that the masking of unfiltered clicks by "pinkish-white" noise does not change over a 30 db range of moderate intensities. Below and above this range masking increases with the intensity of noise, sometimes at a slope greater than one. A.

612.85

9176. Upper frequency limit for human hearing. R. J. PUMPHREY. Letter in *Nature, Lond.*, **166**, 571 (*Sept.* 30, 1950).

Using a pack of Rochelle salt plates (resonant at 100 kc/s) experiments are described which indicate that the upper limit of hearing for airborne sound is below 16·5 kc/s. By pressing the vibrating crystal pack firmly on the mastoid or on the temporal region, a sound was heard at all frequencies up to the limit of the oscillator (i.e. above 100 kc/s). The pitch associated with these "conduction" sounds was approximately that of the highest tone audible by

air conduction. It is concluded: (1) that the sensory elements at the basal end of the cochlea are competent to respond to sounds up to 100 kc/s in frequency; (2) that the failure of the normal ear to respond to sounds above 20 kc/s is due wholly to the failure of the middle ear to transmit such frequencies.

A. B. WOOD

612.85

9177. The trill threshold. G. A. MILLER AND G. A. HEISE. *J. Acoust. Soc. Amer.*, **22**, 637–8 (*Sept.*, 1950).

Two tones of different frequencies alternated successively 5 times per sec. When the difference in frequency was small, the alternation sounded like a continuous up-and-down movement of the pitch. When the difference in frequency was large, the alternation sounded like two unrelated, interrupted tones. The transition point between these two perceptual organizations is called the trill threshold. It was measured as a function of frequency for 14 subjects. A.

612.85 : 534.321

9178. Change in pitch of sustained musical note by clenching of the jaws of the observer. V. B. COREY. Letter in *J. Acoust. Soc. Amer.*, **22**, 640 (*Sept.*, 1950).

612.85 : 534.839

9179. On the masking pattern of a simple auditory stimulus. J. P. EGAN AND H. W. HAKE. *J. Acoust. Soc. Amer.*, **22**, 622–30 (*Sept.*, 1950).

A narrow band of noise was used to mask pure tones. The "beat" heard in the immediate vicinity of the masking noise is not prominent, and a test tone higher in frequency than the band of noise is detected in terms of the characteristic pitch of that tone rather than by means of a difference tone. With a band of noise slightly wider than a critical band (Fletcher), the amount by which the test signal at the centre of the band exceeds the level/cycle of the noise is less than that obtained with a considerably wider band of noise. This smaller signal-to-noise ratio obtained with the narrow band of noise is probably due to "beats," since the test tone is heard as a "buzz" or "rattle." For purposes of deriving excitation or loudness patterns, a better estimate of the maximum amount of masking is obtained by using a wide band of noise whose pressure-spectrum level is the same as that of the narrow band. A.

614.898

9180. Improved film badge for personnel monitoring. R. BAKER AND L. B. SILVERMAN. *Nucleonics*, **7**, 26–34 (*July*, 1950).

A dental film badge incorporating Pb and Ag filters is described. This permits fairly accurate dosage determination for exposures to widely varying radiation energies. Calibration data for these badges is given for 250 keV and 85 keV X-rays and Ra and U gamma-rays. L. R. SHEPHERD

614.898

9181. Reduction in lethal effect of X-radiation by pretreatment with thiourea or sodium ethane dithiophosphonate. R. H. MOLE, J. ST. L. PHILPOT AND G. R. V. HODGES. Letter in *Nature, Lond.*, **166**, 515 (*Sept.* 23, 1950).

615.84 : 537.226

9182. Dielectric properties of the human body fo wave-lengths in the 1–10 cm. range. T. S. ENGLAND Letter in *Nature, Lond.*, **166**, 480–1 (*Sept.* 16, 1950).

An extension of previous work on 3 cm [Abstr. 583 (1949)]. Measurements are made on surgical spec mens of skin, fat, bone, etc., and show similar tren to water, though fat and bone are relatively tran parent. The absorption at 10 cm is about double th of pure water, showing an ionic conductivity of abou 0·01 mho. Results for normal and malignant tissu are tabulated for 3 wavelengths. F. T. FARME

615.84

9183. The röntgen dosage unit, and the relatio between physical dose and biological effect for ioniziri radiation. R. JAEGER. *Abh. Braunsch. Wiss. Gesel* **2**, 85–91 (1950) *In German.*

Experimental curves for mass absorption coefficien in various body substances are given for X-rays fro 22 kV to 4 MeV. The röntgen definition, and neces sary modifications for a dosage unit applicable to th X-rays excited at above 1 MeV, now increasing available, are discussed. Gray's formula, Mayneord gramme-röntgen, the "rep" and "rem" are con sidered. Desirable characteristics of a new clinic radiation unit are formulated under heading (1) Physical dose, (2) Energy absorption in tissue an methods of measurement, and (3) Variation biological response with wavelength of incident X-ray The latter uses Cohen's (1949) work on the effect dose-fractionation and field size. D. V. MAB

615.849 : 616-

9184. Some general problems in connection with th measurement of radioactivity in patients. N. VEAL *Brit. J. Radiol.*, **23**, 527–34 (*Sept.*, 1950).

Paper 1 of "Diagnostic and therapeutic uses radioactive isotopes"—a symposium held by th British Institute of Radiology in January, 195 General considerations concern the accuracy aime at, in view of biological material. Justifiable refin ments include reduction of background count by l shielding, easily manipulated apparatus (often involv compromise with shielding), automatic recording results, highest possible counter efficiency. Expe ments fall into types where radioactivity in a bo organ is measured (*a*) as a function of time an (*b*) as a distribution at a given time. Type (*a*) includ uptake of I^{131} in thyroid (with a shadow method f consistency in setting patient) and use of Na^{24} f studying local blood circulation. Here, variations flow with patient in different surrounding te peratures led to abandonment of experimen Examples of type (*b*) are: (i) localization of placen with Na^{24}, entailing rapid qualitative measuremen with a short-response counting rate meter and unshielded counter; (ii) distribution of I^{131} in thyro tissue, measured quantitatively with a lead-catho counter tube and collimator (drawing give Arrangement resolves two separate point sourc 1·5 cm apart, at 25 cm distance. Distribution thyroid, obtained with this counter, is shown.

D. V. MAB

616–073.75

9185. A safety device for demountable X-ray tubes. R. Léger and C. Legrand. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 12) 150–2 (1950) *In French.*

Circuit described provides automatic cut-out of tension when (*a*) pressure of cooling water is too low, (*b*) vacuum in the X-ray tube is low enough to allow discharge, and (*c*) X-ray-tube filament ruptures. Water circulates automatically with switch-on, but the circuit will not hold until a gravity-fed relay in the return pipe also makes contact. When the vacuum is low enough to allow a discharge in the X-ray tube, a series milliammeter momentarily reaches maximum deviation and, through a contact at this point, makes a circuit governing a cut-out relay in the primary lead. If the filament ruptures, current in the primary of the transformer supplying it is insufficient to hold a relay in this circuit. Breaking this relay again operates the main cut-out relay, and all tension is removed. A recording ammeter indicates the time of breakdowns. D. V. MABBS

TECHNICAL MATERIALS 66/67

666.1 : 535.555

9186. The lamellar structure and birefringence of plate glass. C. V. Raman. *Proc. Indian Acad. Sci.*, *A*, **31**, 359–64 (*June*, 1950).

Using carefully prepared material with adequate magnification under conditions securing the optimum visibility, photographs exhibiting the lamellar structure of plate glass and the associated birefringence have been secured which exhibit far more detail than previously. The visibility of the structure is closely related to the diffraction phenomena to which it gives rise. The latter are described and discussed in detail. A.

666.22 : 539.219.1

9187. A study of inhomogeneity in large glass disks. B. Lyot and M. Françon. *Rev. Opt.* (*Théor. Instrum.*) **29**, 499–512 (*Oct.*, 1950) *In French.*

The principal inhomogeneities in optical glass take the form of long threads less than 1 mm in diameter which have a refractive index slightly greater than their surroundings. They can be accurately located by phase contrast methods and those near the surface eliminated. R. O. DAVIES

669 : 541.123.6

9188. On the phases occurring in alloys of aluminium with copper, magnesium, manganese, iron, and silicon. G. Phragmén. *J. Inst. Met.*, **77**, 489–552 (*Aug.*, 1950).

669.018 : 541.123.3

9189. The system silver–magnesium–antimony, with reference to the theory of alloy formation. B. R. T. Frost and G. V. Raynor. *Proc. Roy. Soc.*, *A*, **203**, 132–47 (*Sept.* 7, 1950).

For comparison with the recently determined equilibrium diagrams of the Ag–Mg–Zn and Ag–Mg–Sn alloys, the system Ag–Mg–Sb has been studied by metallographic and X-ray methods. The results are presented in the form of isothermal diagrams at 550 and 450°C. At both temperatures the intermetallic compounds Mg_3Sb_2 and AgMgSb enter into equilibrium with the primary Ag-rich solid solution. At 550°C the solid alloys are confined to a composition region lying approximately between a line joining Mg_3Sb_2 to the Sb-rich side of the ($\zeta + \gamma$) region of the Ag–Sb system, and a line joining Mg_3Sb_2 to the Mg-rich side of the β' region of the Ag–Mg system. Within this region the equilibria are similar to those at 450°C. At 450°C the compound Mg_3Sb_2 enters into equilibrium with Mg, Sb, Mg_3Ag, the β' phase of the Ag–Mg system, and the Ag-rich ternary solid solution. The compound AgMgSb enters into equilibrium with Mg_3Sb_2, Sb, the γ and ζ phases of the Ag–Sb system, and the Ag-rich solid solution. The isothermal diagram, therefore, contains 8 3-phase triangles, and the equilibria are dominated by the 2 intermetallic compounds. The form of the equilibrium diagram is discussed in comparison with previous work, and it is shown that the effect of a compound formed by the solute elements depends on its heat of formation, which can be taken as a rough measure of its free energy. The form of the α boundary, at which both AgMgSb and Mg_3Sb_2 come into equilibrium with α, is consistent with the ideas of Hume–Rothery, according to whom the isothermal boundary at which a compound B_xC_y separates in the system ABC may be represented by the expression $[B]^x[C]^y$ = constant, where $[B]$ and $[C]$ are, to a first approximation, the atomic percentages of the solute elements. A.

PHOTOGRAPHY 77

77.01

9190. Xerography. *Photogr. J.*, *B*, **90**, 66–8 (*May–June*, 1950).

A brief description is given. See Abstr. 1612 (1949). A. HARVEY

771.31 : 778.37

9191. A 100 000 000-frame-per-second camera. M. Sultanoff. *Rev. Sci. Instrum.*, **21**, 653–6 (*July*, 1950).

Shock waves close to the edge of explosive charges

have been successfully photographed at rates exceeding 100 000 000 frames/sec. These ultra-high framing rates are obtained with a multi-slit focal plane shutter which is transported optically across the film plane by a rotating mirror. Linear shutter speeds up to 3 000 m/sec are easily obtained, and the resulting framing rates with the proper selection of slit widths can be varied from 10^5 to 10^9 frames/sec. Each individual frame is composed of a series of lines, and the degree of "discontinuity" across each frame is proportional to the total number of frames. A.

771.53

9192. Variation of granularity of a photographic deposit with area of scanning spot. R. DEBOT. *Research, Lond.*, **3**, 474–8 (*Oct.*, 1950).

An electronic granularity meter described earlier [Abstr. 3653 (1950)] was used to check the law postulated by Selwyn that the root mean square deviations of the transparencies measured with a scanning spot of area a should be inversely proportional to a. When determined on the original negatives the law is fulfilled with fair accuracy, but with enlargements the deviations are too small for small scanning spots, as one would expect if the enlarging lens were imperfect. For reasons unknown at present, the root mean square deviations fluctuate widely from specimen to specimen of the same emulsion and a large number of readings are necessary to obtain sufficient accuracy. W. F. BERG

771.534.21

9193. Some aspects of the dye sensitization of photographic emulsions. H. O. DICKINSON. *Photogr. J., B*, **90**, 142–7 (*Sept.–Oct.*, 1950).

The relation between the absorption and sensitizing properties of dyes is discussed with special reference to dye polymerization. Recent theories of supersensitization and the mechanism of optical sensitization are reviewed. A.

771.534.54 : 545.828

9194. Effect of plate emulsion contrast factor on the precision of spectrochemical analysis. E. H. S. VAN SOMEREN. Note in *Spectrochim. Acta*, **4** (*No.* 1) 59 (1950).

The author points out the error in the common assumption that the precision of determination of density differences of spectral lines increases with the contrast factor γ of the emulsion, since the standard deviations of readings are also roughly proportional to γ. This is correct under conditions where the error of microphotometric measurements is small compared with the variability introduced by the light source. W. F. BERG

771.534.56

9195. The Schwartzschild coefficient of photographic plates. E. LOEUILLE. Note in *Spectrochim. Acta* (*No.* 1) 57–8 (1950) *In French.*

The note describes the method of determining t Schwartzschild coefficient assuming that the re procity failure curve of the material in question is the catenary form. W. F. BE

771.534

9196. Theory of blackening transformation. V. W KEUSSLER. Note in *Spectrochim. Acta*, **4** (*No.* 60–1 (1950) *In German.*

It is shown that the Seidel blackening transform tion for the correlation between photometer deflecti and the log intensity of exposure leads to the hyp bolic function tan h, which also describes the curve magnetization of a ferromagnetic substance. Of possible modes of representation, this is the on one which admits division into two logarithmic curv which are centrally symmetrical to one another. linear combination of these two logarithmic functio yields the generalized Seidel transformation suggested by Seith. W. F. BE

771

9197. The latent image in the photographic pla K. J. KELLER. *Ned. T. Natuurkde*, **16**, 118–26 (*Ju* 1950) *In Dutch.*

Outlines Mott and Gurney's theory of the for tion and development of the latent image and gi an account of some subsequent work, particula that of Webb and Evans, on the effects of temperat variations, which supports the theory. An expla tion of the failure of the Bunsen reciprocity law also given in terms of the theory. J. THEW

778.3 : 535.373 : 53

9198. Thermography. F. URBACH. *Photogr. B*, **90**, 109–14 (*July–Aug.*, 1950).

Certain phosphors are so temperature-sensiti that localized small increases in temperature rev themselves as relatively dark areas when the phosph are illuminated by ultraviolet light. These differen of temperature may be produced by having phosphor in contact with a body of which the te perature distribution is required, or by forming image of the body on a thin sheet of phosphor reflection of the heat radiation from it. In either c the phosphor exhibits a picture of the temperatu which may be photographed if a permanent record required. Accurate "temperature maps" may produced by photographic photometry from su photographs. These processes are described a discussed in some detail.

778.34 : 534.59

Mean free path of cosmic ray ionizing particles photographic emulsions. *See Abstr.* 8848

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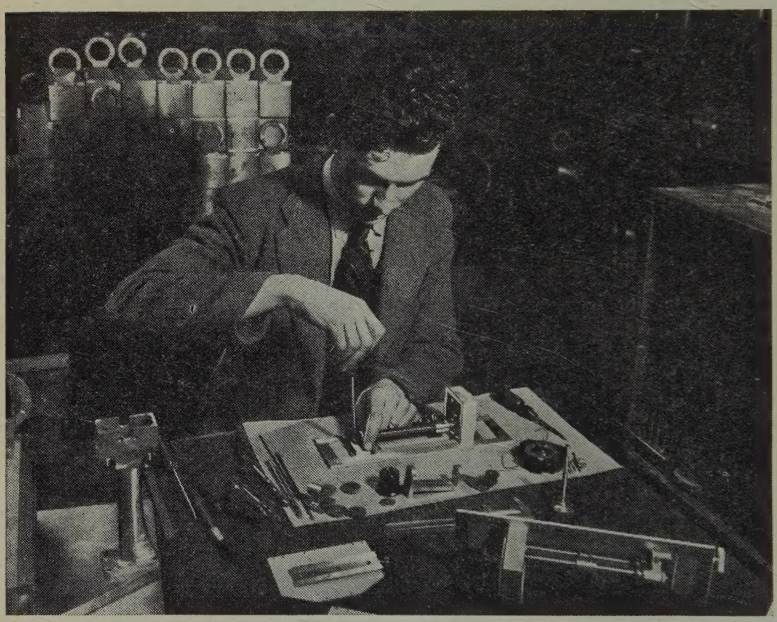

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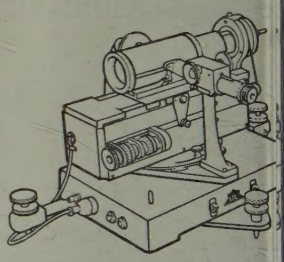

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